THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: Venkata Bhaskara Narasimha Sastry Madduri

TITLE OF THESIS: Economic Analysis of Fertility Behaviour in Canada: An Examination of 1971 Census Data

DEGREE FOR WHICH THESIS WAS PRESENTED: Ph.D

YEAR THIS DEGREE GRANTED: 1979

THE UNIVERSITY OF ALBERTA

ECONOMIC ANALYSIS OF FERTILITY BEHAVIOUR IN CANADA: AN EXAMINATION OF 1971 CENSUS DATA

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

IN

ECONOMICS

DEPARTMENT OF ECOMONICS

EDMONTON, ALBERTA

FALL, 1979

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Economic Analysis of Fertility Behaviour in Canada: An Examination of 1971 Census Data," submitted by V. B. N. Sastry Madduri in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Economics – Demography

ABSTRACT

This dissertation examines the economic determinants of fertility behaviour in Canada. The 1971 Canada Census information was used to study the nature and direction of socio-economic influences on fertility. By applying the theory of consumer behaviour, an economic model of fertility behaviour is presented. Three different specifications for estimating the demand for children are explored. A simultaneous equation model of fertility is attempted to capture the cause and effect relationship between fertility and married female labour force participation rates.

This model suggests that income-fertility relationship is non-linear. The simultaneous equation model is favoured to the other three specifications. Based on the significance of coefficients it appears that low and high income families are more sensitive to the socio-economic factors than the middle income families. This study indicates that the participation in the labour force of married women is a deterrent to fertility. This has consequences for the future population and labour force growth in Canada.

ACKNOWLEDGEMENTS

I would like to express sincere gratitude to my supervisors, K. L. Gupta and P. Krishnan who provided valuable advice and spent many hours discussing various aspects of the thesis with me. I am also greatful to W. C. Riddell for his help in clearing econometric problems I faced in the thesis.

I am thankful to Allen Sharpe for his valuable assistance in computer programming. I am also thankful to N. M. Lalu who helped me in picking up PUST data sample. I am greatful to Lynn Tait and Bernie D'Aoust for their expert editorial help in putting the thesis together. My thanks are to K. Venkateswarlu for tracing graphs. I would like to thank Evelyn Brady for her expert typing.

Finally, I am greatly indebted to my wife and mother-in-law who relieved me from household duties and encouraged me to complete this thesis.

I wish to acknowledge my colleagues at the Planning Secretariat, Advanced Education and Manpower for their encouragement.

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CHAPTER I

INTRODUCTION

This dissertation examines the economic determinants of human reproductive behaviour in Canada. Economists and other social scientists have been attempting to explain the relationship between economic and social processes and household behaviour responsible for the observed decline of high birth rates to the modern low birth rates. This process of declining birth rates, often referred to as demographic transition (Schultz, 1973, p. S4), has serious consequences for future population replacement needs, human resource requirements, and economic progress in the country.

Although there is no satisfactory economic theory explaining birth rates, recent developments in economic literature assist in explaining differences in human fertility behaviour in an economic framework. Harvey Leibenstein and Gary S. Becker pioneered in providing an economic framework for human reproductive behaviour. Leibenstein (1957) related fertility to economic growth while Becker (1960) analysed fertility behaviour by applying the micro-economic theory of consumer behaviour. The economic theory of households suggests that households combine market goods and services with their own time and produce consumption goods, using household production functions at a given level

of consumer technology. The inputs of the household production function are the family member's time and market goods.

Willis (1973) generated a demand for children relationship by maximizing a family utility function with children and other standard of living goods as arguments subject to income and time constraints. This micro-economic framework of fertility behaviour was the source of many empirical studies elucidating the process of demographic transition (Ben Poarth, 1973; De Tray, 1973; Gardner, 1973; Michael, 1973). The derived income and substitution effects added to the knowledge of human reproductive behaviour.

Canada has experienced wide swings in birth rates including high birth rates following the war years and very low birth rates in recent years. The declining birth rates will reduce the furture supply of the Canadian labour force (Denton and Spencer, 1978). However, the economic nature of Canadian demographic transition has not been explored and there are no comprehensive models explaining Canadian fertility behaviour in the framework of "economic theory of the family." In order to assess the possibility of future manpower shortages, research on socio-economic factors that determine fertility behaviour in Canada is warranted. This dissertation attempts to explain Canadian fertility behaviour using the new economic approaches to fertility. The complex network of social and economic factors that influence fertility are identified and estimated. For example, family

income and the wife's wages, education, religion, age at marriage, technical skills and immigration status are some of the variables which interact with fertility. The impact of these factors is derived by estimating four different fertility models.

First, a linear model with a linear relationship between fertility and socio-economic variables is specified and estimated. Second, an interaction model with a non-linear relationship based on Willis'(1973) study is tested. Third, an alternative non-linear model with a log specification is attempted to capture the non-linear relationship between fertility and income.

The decline in birth rates in Canada is, in part, a result of the observed increase in female labour force participation. Labour force participation of married women and birth rates are simultaneously determined by the same economic variables. In order to capture this causality, a simultaneous equation model with fertility and married women labour force participation as endogenous variables is specified as the fourth model.

Selection of appropriate data for studying fertility behaviour is an important part of the analysis. The 1971 Canada Census is a rich source of information for analysing Canadian fertility behaviour. A one-in-one hundred sample base, Public Use Sample Tape (PUST), was used to estimate the four fertility models. The ordinary least squares method of estimation is used to estimate the linear and non-linear

models and two stage least squares method for the simultaneous equation model.

In the next chapter, an overview of the social and economic variables influencing Canadian birth rates is provided. The third chapter discusses an economic framework of fertility behaviour based on the economic approaches to fertility. The specifications of these four fertility models are also described. In the fourth chapter, these four models are estimated and a summary of estimates and elasticities are discussed. In the fifth chapter these results are compared with other findings. The final chapter summarizes the implications of this thesis and suggests some directions for future economic research on the fertility behaviour of Canadian married women.

CHAPTER II

DATA AND ANALYSIS OF CANADIAN FERTILITY BEHAVIOUR

2.1 Introduction

The aim of this chapter is to provide an overview of fertility behaviour in Canada. A complex network of social and economic factors influence fertility and it is important to know the nature and direction of these influences. The 1971 Canada Census is a particularly rich source of information for this investigation. In the beginning of this chapter, the sources of data, their limitations and definitions are given. Later, the main aspects of Canadian fertility behaviour are discussed by means of tabular analysis.

2.2 Data

The Canadian Census was taken in June, 1971. A representative sample of records from the Census Master File was released as Public Use Sample Tape (PUST). The primary sample is one-in-one hundred. The sample is self-weighting with each record assigned a weight of 100. Thus, in order to estimate the frequency of any variable for the entire population, the tabulations will have to be multiplied by 100.

The data for the PUST have been organized into three separate files: individual, household, and family files.[1]

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[1]Household File contains detailed housing data as well as some basic demographic information on the occupants of the household. Family File gives detailed information on the head and spouse of the census family as well as grouped data on other members of the family.

For each of these basic files, an independent stratified sample was taken from the 1971 Census master file. A record from the individual files contains detailed demographic and economic data for individuals along with a few family and housing characteristics.

There are two major limitations of the PUST. First, the PUST contains only a sample of observations and one cannot expect complete agreement between Census publications which are actual counts and user estimates based on a sample. Secondly, due to confidentiality, sampling was restricted to areas with a minimum population of 250,000 persons. As a result, sampling was done for only nine of the provinces, namely Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario, Minitoba, Saskatchewan, Alberta, and British Columbia. Sample data for Prince Edward Island, Yukon and Northwest Territories are not available. Details of sampling procedures are available in "Public Use Sample Tape--User Documentation" (Statistics Canada, 1975).

We utilize all the individual records,namely 46,376,to analyse the fertility behaviour in Canada. Furthermore, the analysis is restricted to married females aged 15 years and over living together or apart from the husband, but not divorced or separated. Some of the variables selected for this study are defined below.

2.3 Definitions[1]

Geographic Code (GEO-CODE):[2] This refers to the province of residence of the individual. Nine provinces in Canada are included. Prince Edward Island, the Yukon, and the Northwest Territories are excluded.

Number of persons in Family (FAM-SIZE): This is the total number of persons in the Census family. A Census family consists of a husband and wife (with or without children who have never been married, regardless of age) or a parent with one or more children never married, living in the same dwelling.

Age (AGE): This is the age in completed years as of their last birthday before the Census date.

Period of Immigration (PRDIMMIG): This refers to the year when persons born outside Canada first came to live in Canada. From the date of entry, the number of years the immigrant has been in Canada is calculated.

Religion (USRELIG): This refers to the specific religious body, denomination, sect or community reported in answer to the question, "what is your religion?"

Level of Schooling (EDUCAT): This refers to the highest grade or year of elementaty school, secondary school or university attended.

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[1]The definitions are from the Dictionary of the 1971 Census Terms (Statistics Canada, 1972).

[2]These are the mnemonics used in the PUST record layout.

Completed Full Time Course (TRAINING): This includes additional training obtained through apprenticeship or by means of some other full-time vocational course. Courses dropped before completion were not included.

Number of Children Ever Born (BABIES): This refers to the number of children ever born alive, whether born of the present marriage or any previous marriage. Respondents were asked to list children who died after birth as well as those residing elsewhere at Census time, excluding adopted and stepchildren. Only married women were asked to complete the question regarding the number of children ever born.

Labour Force Status (LFCODE1): This includes people who worked for pay or profit in the armed forces or civilian work force, worked in unpaid family work, looked for work, were temporarily layed off, had a job but were not at work (armed forces and civilian work force), were not in the labour force (non-inmate and inmate). This excludes female farm workers who indicated that they helped without pay on a family farm for less than 20 hours, and inmates of institutions.

Income (INCTOTAL): This refers to the total income received during 1970 from wages and salaries, business or professional practice, farm operations, family and youth allowances, government old age pensions, other government payments, retirement pensions from previous employment,

bond and deposit interest and dividends, other investment sources, and any other sources.

Age at First Marriage (AGEFTMAR): The age at first marriage was determined by combining information on the date of first marriage with the date of birth.

Family Income (USFAMINC): This refers to the sum of income received by all members of a family 15 years and over during the calendar year 1970 from all sources. This includes wages and salaries, net income from business and professional practice, net income from farm operations, transfer payments, retirement pensions, investment income and other miscellaneous sources.[1]

Place of Residence (TYPE-71): This refers to the place where a person normally lives and sleeps. Persons are classified according to the size of the local area of residence. The place of residence is grouped as urban and rural areas.

Income from wages and Salaries (INCWAGES): This refers to total wages and salaries (before deductions) received during 1970, including military pay and allowances, tips, commission and bonuses, and piecerate reimbursement. Wages and salaries earned while non-residents of Canada (i.e., prior to immigration) have been excluded.

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[1]There are two other measures of income, income by major source and income from self employment, reported in the PUST data base. The major source of income is listed by the kind of income. Income from self employment is negligible for married females. So these two income categories are not analysed here.

2.4 Analysis of Data

This part of the chapter summarizes some of the main features of the data on fertility behaviour. In order to understand the characteristics of fertility behaviour the relevant data are described by cross tabulations. As in any other industrialized society, Canadian fertility behaviour varies across regions, income groups, education levels, and age groups. The Canadian married women aged 15 years and over are cross-classified by the following socio-economic characteristics: province of residence, age group, educational attainment, labour force activity, religion, place of residence, age at first marriage, income level, and family income.

2.4.1 Residence and Fertility[1]

Table 2.1 shows Canadian married women aged 15 years and over by province of residence and age group along with number of children ever born per 1000 married women. It is estimated that the average number of children ever born per 1000 ever married women is 2,666. One can see that fertility rates vary across the country from a high of 3,866 in Newfoundland to a low of 2,320 in British Columbia. Ontario has the next lowest level of fertility. Manitoba and Alberta are close to the national average. Married women in Newfoundland have a 77% higher fertility rate than those in British

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[1]Fertility is measured by the number of children ever born per 1000 ever married women.

TABLE 2.1

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING PROVINCE OF RESIDENCE AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

PROVINCE	AGE GROUP IN YEARS										Total 15 +	Number of Children Ever Born per 1000 Married Women
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 +		
	%	%	%	%	%	%	%	%	%	%	%	
Newfoundland	24	148	165	97	107	103	118	84	54	121	1021	3866
	3.4	3.0	2.7	1.7	2.0	2.0	2.4	2.0	1.6	2.1	2.2	
Nova Scotia	24	175	220	199	161	172	169	177	124	221	1642	3010
	3.5	3.5	3.6	3.6	3.0	3.3	3.4	4.2	3.7	3.7	3.5	
New Brunswick	29	156	154	143	145	151	121	124	92	184	1299	3375
	4.1	3.1	2.5	2.6	2.7	2.9	2.4	2.9	2.8	3.1	2.8	
Quebec	105	1235	1772	1630	1471	1459	1349	1085	868	1443	12417	2906
	14.8	24.7	28.8	29.2	27.6	28.0	27.3	25.9	26.1	24.5	26.8	
Ontario	288	1884	2239	2062	2036	2023	1871	1579	1202	2225	17409	2432
	40.5	37.6	36.4	36.9	38.2	38.8	37.8	37.5	36.2	37.7	37.5	
Manitoba	33	236	275	223	225	222	241	209	162	324	2150	2666
	4.6	4.7	4.5	4.0	4.2	4.3	4.9	5.0	4.9	5.5	4.6	
Saskatchewan	39	205	222	260	194	203	216	191	174	303	2007	2929
	5.5	4.1	3.6	4.7	3.6	3.9	4.4	4.5	5.2	5.1	4.3	
Alberta	72	421	496	447	435	361	337	310	234	405	3518	2687
	10.1	8.4	8.1	8.0	8.2	6.9	6.8	7.4	7.0	6.9	7.6	
British Columbia	97	546	615	520	552	519	525	456	414	669	4913	2320
	13.1	10.9	10.0	9.3	10.4	10.0	10.6	10.8	12.5	11.3	10.6	
Total (100%)	711	5006	6158	5581	5326	5213	4947	4215	3324	5895	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

Columbia. Quebec's birth rate is 25% higher than British Columbia, and 9% higher than the national rate. Collishaw (1976) documented these wide variations in Canadian fertility rates. He observed that Ontario and British Columbia have the lowest fertility. "Their fertility rates have been below the national total fertility rates in almost all the years since 1921" (Collishaw, 1976, p. 8). The Maritime provinces along with Saskatchewan and Alberta have traditionally had high total fertility rates, their rates being consistently higher than the national rate since 1921. It appears that industrialized provinces like British Columbia and Ontario tend to have lower birth rates than the less developed regions like the Maritime provinces.

In 1971, the demographic structure of married women indicates that the highest percentage (13%) of married women are in the 25-29 age group. There are fertility differentials across the age groups. Married females in the 40-44 years age group have the highest number of children ever born per 1000 married women. For all women of age 35 and over, the fertility rate is consistently higher than the national average. Most of the Canadian women complete their childbearing by 44 years of age.

One would expect that place of residence is related to fertility (Kiser, 1968). The Canadian married women living in urban or rural areas are tabulated by age and fertility in Table 2.2. From the table one can see that urban women

TABLE 2.2

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING PROVINCE OF RESIDENCE AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

PLACE OF RESIDENCE	AGE GROUP IN YEARS											Number of Children Ever Born per 1000 Married Women
	15-19 %	20-24 %	25-29 %	30-34 %	35-39 %	40-44 %	45-50 %	50-54 %	55-59 %	60 + %	Total 15 + %	
Urban	539 75.8	4043 80.8	4861 79.9	4356 78.1	4174 78.4	4052 77.7	3794 76.7	3219 76.4	2465 74.2	4345 73.7	35848 77.3	2453
Rural	172 24.2	961 19.2	1297 20.1	1224 21.9	1149 21.6	1160 22.3	1152 23.3	995 23.6	858 25.8	1547 26.3	10515 22.7	3397
Total (100%)	711	5004	6158	5580	5323	5212	4946	4214	3323	5892	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

have a lower fertility level of 2,452 when compared to rural women with a fertility level of 3,397. In other words the urban fertility rate is 28% lower than the rural fertility rate. Nearly 77% of Canadian married women live in urban areas, but their fertility level is 8% less than the national level.

2.4.2 Age at Marriage and Fertility

It appears that age at marriage and the proportion of married women in the population are important in fertility analysis. This hypothesis is evident from Table 2.3. In Table 2.3, the number of married women aged 15 years and over showing age at first marriage and mother's age group along with number of children ever born is reported. The early married females have the highest birth rate of 3,188 children per 1,000 married women. This table suggests that the birth rate decreases as the age at marriage increases. According to the 1971 Census data, nearly 49% of Canadian married women are married between 20 and 24 years of age. This group has the highest number of children ever born. However, some researchers point out that women with higher levels of education tend to delay marriage and also postpone child-bearing (Michael, 1973). Thus, age at marriage is related to fertility through the intervening variable of education. Other indirect relationships of marriage and fertility through intervening variables such as occupation, ethnic group, or religion can also be suggested.

TABLE 2.3

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING AGE AT FIRST MARRIAGE AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

AGE AT FIRST MARRIAGE	AGE GROUP IN YEARS 15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 +	Total 15 + %	Number of Children Ever Born per 1000 Married Women
Age Group 15-19	711	2076	1871	1740	1419	1226	971	664	505	1099	12282 26.5	3188
20-24	0	2930	3632	2872	2812	2648	2498	1996	1311	2206	22905 49.4	2653
25-29	0	0	655	815	793	958	1017	964	892	1360	7454 16.1	2406
30-34	0	0	0	154	233	240	305	340	357	607	2236 4.8	1901
35-39	0	0	0	0	69	106	93	136	129	281	814 1.8	1232
40-44	0	0	0	0	0	35	49	59	68	145	356 0.8	1129
45-49	0	0	0	0	0	0	14	41	33	69	157 0.0	637
50-54	0	0	0	0	0	0	0	15	19	50	84 0.0	821
55-59	0	0	0	0	0	0	0	0	10	24	34 0.0	765
60 +	0	0	0	0	0	0	0	0	0	54	54 0.0	1222
Total (100%)	711	5006	6158	5581	5326	5213	4947	4215	3324	5995	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

2.4.3 Religion and Fertility

Religious affiliations have one of the most pronounced influences on fertility (Westoff, 1971). For example, the use of contraception is discouraged by certain religious groups. Traditionally, Catholics have had the largest families and Jews the smallest.[1] The Canadian Census provides an opportunity to examine this conjecture. Table 2.4 summarizes the number of married women according to religious denominations and age along with number of children ever born. Mennonite and Hutterite communities have the highest number of births per 1,000 women. However, their proportion of the total married female population is only 0.8%. Nearly 44% of married females belong to the Roman Catholic church and their birth rate is the second highest, 2,980 births per 1,000 Catholic married women. As expected, Jewish women, who form 1.5% of the married women population. have the lowest birth rate of 1,940 per 1,000 married women. Jewish women have a 27% lower and Catholic women have a 10% higher fertility rate than the national average of 2,666.

The geographic and religious differentials in fertility in Canada were documented by Rao (1973). His findings based on the 1961 Census of Canada,suggest that Quebec and Roman Catholic women had the highest fertility rates in

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[1]According to a Princeton Fertility Study, "Catholic couples wanted the most and Jewish couples the fewest children, with Protestants in an intermediate position" (Kiser et al., 1968, p. 233).

TABLE 2.4

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING RELIGION AND AGE GROUP ALONG WITH

NUMBER OF CHILDREN EVER BORN, CANADA, 1971

RELIGION	AGE GROUP IN YEARS 15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 +	Total 15 + %	Number of Children Ever Born per 1000 Married Women
Anglican	98	594	694	591	595	651	699	620	452	890	5884 12.7	2430
Baptist	28	158	190	160	161	169	155	137	130	261	1549 3.3	2586
Greek Orthodox	13	70	97	88	83	81	75	56	62	114	739 1.6	2203
Jewish	1	45	67	66	60	61	83	99	59	138	679 1.5	1940
Lutheran	30	133	198	224	214	197	200	154	140	236	1726 3.7	2369
Mennonite & Hutterite	2	41	54	58	36	34	27	35	23	56	366 0.8	3582
Pentecostal	13	55	65	46	48	28	46	32	32	70	435 0.9	2936
Presbyterian	19	157	213	198	203	240	236	205	175	356	2002 4.3	2214
Roman Catholic	294	2350	2882	2746	2514	2353	2027	1648	1270	2079	20165 43.5	2980
Ukrainian Catholic	7	38	59	46	57	60	72	56	52	84	531 1.1	2550
United Church	140	890	1083	920	954	963	1004	895	710	1285	8844 19.1	2418
No Religion	36	231	267	189	184	176	137	120	75	88	1503 3.2	1993
All Other	28	244	289	249	217	200	186	158	144	238	1953 4.2	2774
Total (100%)	711	5006	6158	5581	5326	5213	4947	4215	3324	5895	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

Canada. Married women aged 15 years and over by religion and place of residence along with number of children ever born is shown in Table 2.5. In Quebec, 86% of married women belong to the Roman Catholic church, the highest participation in a religious group in any one province in Canada. The next highest participation in a Catholic group is in New Brunswick, which has the second highest fertility rate. The lowest percentage of Catholic women, 17.2%, were in British Columbia, which has the lowest fertility rate.

2.4.4 Education and Fertility

A negative correlation between parents' education and completed fertility is one of the most widely observed relationships in the empirical literature (Michael, 1973). Education influences fertility via knowledge of contraceptive choice, selection of mate, earning potential, age at marriage, efficiency in consumption, etc. To elucidate this phenomenon, a breakdown of married women aged 15 years and over by level of schooling and age group along with number of children ever born is reported in Table 2.6. Nearly 34% of Canadian women have less than grade 9. Cumulatively, nearly 92% of Canadian married women have grade 13 or less. The negative relationship between fertility and education is evident from the last column of the table. Married women with less than grade 9 have the highest fertility rate of 3,431, which is 29% higher than the national average. Only 2.8% of married women have a university degree and the fertility rate for this group is

TABLE 2.5

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING RELIGION AND PROVINCE OF RESIDENCE ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

RELIGION	PROVINCE OF RESIDENCE										
	NFLD %	N.S. %	N.B. %	QUE %	ONT %	MAN %	SASK %	ALTA %	B.C. %	TOTAL %	NUMBER OF CHILDREN EVER BORN PER 1000 MARRIED WOMEN
Anglican	293 28.7	304 18.5	168 12.9	380 3.1	2884 16.6	261 12.1	220 11.0	409 11.6	965 19.6	5884 12.7	2430
Baptist	4 0.0	226 13.8	196 15.1	86 0.7	675 3.9	44 2.0	33 1.6	114 3.2	171 3.5	1549 3.3	2586
Greek Orthodox	0 0.0	4 0.0	1 0.0	140 1.1	292 1.7	67 3.1	72 3.6	103 2.9	60 1.2	739 1.6	2203
Jewish	1 0.0	7 0.0	1 0.0	281 2.3	317 1.8	38 1.8	4 0.0	13 0.0	17 0.0	679 1.5	1940
Lutheran	3 0.0	25 1.5	4 0.0	61 0.0	697 4.0	162 7.5	201 10.0	287 8.2	286 5.8	1726 3.7	2369
Mennonite & Hutterite	0 0.0	0 0.0	0 0.0	2 0.0	88 0.5	123 5.7	54 2.7	40 1.1	59 1.2	366 0.8	3582
Pentecostal	45 4.4	13 0.8	38 2.9	16 0.0	163 0.9	16 0.7	17 0.8	44 1.3	83 1.7	435 0.9	2936
Presbyterian	7 0.7	76 4.6	35 2.7	97 0.8	1267 7.3	90 4.2	51 2.5	130 3.7	249 5.1	2002 4.3	2214
Roman Catholic	322 31.5	534 32.5	619 47.7	10672 85.9	5439 31.2	475 22.1	496 24.7	764 21.7	844 17.2	20165 43.5	2980
Ukrainian Catholic	0 0.0	2 0.0	2 0.0	50 0.0	127 0.7	137 6.4	94 4.7	98 2.8	21 0.0	531 1.1	2550
United Church	246 24.1	374 22.8	186 14.3	425 3.4	4062 23.3	599 27.9	625 31.1	1046 29.7	1281 26.1	8844 19.1	2418
No Religion	2 0.0	33 2.0	18 1.4	100 0.8	579 3.3	59 2.7	44 2.2	174 4.9	494 10.1	1503 3.2	1993
All Other	98 9.6	44 2.7	31 2.4	107 0.9	819 4.7	79 3.7	96 4.7	296 8.4	383 7.8	1953 4.2	2774
Total (100%)	1021	1642	1299	12417	17409	2150	2007	3518	4913	46376	
Number of Children Ever Born per 1000 Married Women	3866	3010	3375	2906	2432	2666	2929	2687	2320		2666

TABLE 2.6

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LEVEL OF SCHOOLING AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LEVEL OF SCHOOLING	AGE GROUP IN YEARS											Number of Children Ever Born per 1000 Married Women
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 +	Total 15 + %	
Grade < 9	140	746	1244	1503	1723	1902	1942	1744	1566	3363	15873 34.2	3431
Grades 9 - 10	265	1216	1523	1421	1409	1335	1155	973	704	1085	11086 23.9	2622
Grades 11 - 13	292	2493	2654	2168	1773	1607	1564	1270	880	1220	15921 34.3	2118
University No Degree	13	339	418	303	282	224	187	163	112	150	2191 4.7	1969
University Degree	1	212	319	186	139	145	99	65	62	77	1305 2.8	1592
Total (100%)	711	5006	6158	5581	5326	5213	4947	4215	3324	5895	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3353	3331	3170	3048	3266		2666

1,592, which is 40% less than the average.

Table 2.7 shows that married women living in urban areas have higher levels of education than those in rural areas. Particularly, 90% of all married women with a university degree live in urban areas. It is likely that a large proportion of married women with higher levels of education migrate to or live in the cities because of employment opportunities. The potential job opportunities in urban areas would increase female labour force activity and would result in lower birth rates.

2.4.5 Labour Force Participation and Fertility

As suggested by Becker (1965), investment in human capital in the form of education encourages housewives to allocate more time towards market work, income earning activities, and less to household duties. Increased participation in the labour force decreases the level of fertility, because, by allocating more of their time to market related activities married women will have less time for household duties like bearing and rearing of children. Table 2.8 shows married women according to their labour force status and age groups along with number of children ever born. In Canada, 36% of married women participate in the labour Force. The fertility level of women who were in the labour force in 1970 was 39% less than the national average, while the number of children ever born per 1,000 non-working mothers is 11% higher than the average. Age specific participation rates

TABLE 2.7

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING PLACE OF RESIDENCE AND LEVEL OF SCHOOLING ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

PLACE OF RESIDENCE	Grade < 9 %	Grades 9-10 %	Grades 11-13 %	University No Degree %	University Degree %	Total %	Number of Children Ever Born per 1000 Married Women
Urban	11380	8529	12936	1826	1177	35848	2452
	71.7	76.9	81.3	83.4	90.3	77.3	
Rural	4490	2556	2978	364	127	10515	3397
	29.3	23.1	18.7	16.6	9.7	22.7	
Total (100%)	15870	11085	15914	2190	1304	46376	
Number of Children Ever Born per 1000 Married Women	3431	2622	2118	1969	1592		2666

TABLE 2.8

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LABOUR FORCE STATUS AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LABOUR FORCE STATUS	AGE GROUP IN YEARS											Number of Children Ever Born per 1000 Married Women
	15-19 %	20-24 %	25-29 %	30-34 %	35-39 %	40-44 %	45-49 %	50-54 %	55-59 %	60 + %	Total 15 + %	
Not in the Labour Force	445 62.6	2510 50.1	3750 60.9	3568 63.9	3254 61.1	3064 58.8	2978 60.2	2602 61.7	2251 62.7	5150 87.3	29572 63.8	2968
In the Labour Force	266 37.4	2496 49.9	2408 39.1	2013 36.1	2072 38.9	2149 41.2	1969 39.8	1613 38.3	1073 32.3	745 12.7	16804 36.2	2135
Total (100%)	711	5006	6158	5581	5326	5213	4947	4215	3324	5896	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

indicate that the 20-24 year age group has the highest participation rate (50%) and a corresponding fertility rate of 882 per 1,000 married women. In the 40-44 year age group, the fertility rate of 3,372 is the highest, and the participation rate of 41% is the second highest.

The low fertility characterising the economically active married women in Canada is analysed in relation to urban-rural residence status. Table 2.9 shows that a large proportion of women in the labour force are from urban areas.

2.4.6 Education, Labour Force Participation and Fertility

Increased entrance of women into the labour force reflects, in part, rising education levels of the female population and the more varied employment opportunities associated with higher education and technical and professional training. Given the relation between education and labour force participation, it may be that the differentials in fertility between participants and non-participants in the labour force reflects the effect of education rather than labour force status per se. From Table 2.10, it is evident that the percentage of married women participating in the labour force increases as levels of education increase.

Table 2.11 shows the number of children ever born to married women aged 15 years and over according to the level of schooling and the labour force status. It is evident

TABLE 2.9

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING PLACE OF RESIDENCE AND LABOUR FORCE STATUS ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

PLACE OF RESIDENCE	LABOUR FORCE STATUS			Number of Children Ever Born per 1000 Married Women
	Not in the Labour Force %	In the Labour Force %	Total %	
Urban	22414 75.8	13444 80.0	35858 77.3	2452
Rural	7156 24.2	3362 20.0	10518 22.7	3397
Total (100%)	29562	16801	46376	
Number of Children Ever Born per 1000 Married Women	2968	2136		2666

TABLE 2.10

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LABOUR FORCE STATUS AND LEVEL OF SCHOOLING ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LABOUR FORCE STATUS	LEVEL OF SCHOOLING						Number of Children Ever Born per 1000 Married Women
	Grade < 9	Grades 9-10	Grades 11-13	University No Degree	University Degree	Total	
	%	%	%	%	%	%	
Not in the Labour Force	11945 75.3	7243 65.3	8739 54.9	1053 48.1	592 45.4	29572 63.8	2968
In the Labour Force	3928 24.7	3843 34.7	7182 45.1	1138 51.9	713 54.5	16804 36.2	2135
Total (100%)	15873	11086	15921	2191	1305	46376	
Number of Children Ever Born per 1000 Married Women	3431	2622	2118	1969	1592		2666

TABLE 2.11

NUMBER OF CHILDREN EVER BORN TO MARRIED WOMEN OF AGE 15 YEARS AND OVER ALONG WITH LABOUR FORCE STATUS, CANADA, 1971

LEVEL OF SCHOOLING	NUMBER OF CHILDREN EVER BORN PER 1000 MARRIED WOMEN		
	Not in the Labour Force (64%)	In the Labour Force (36%)	Total
Grade < 9	3616	2869	3431
Grades 9 - 10	2783	2319	2622
Grades 11 - 13	2382	1797	2118
University No Degree	2214	1742	1969
University Degree	2160	1119	1592
Total	2968	2135	2666

that fertility varies inversely with education regardless of labour force participation. Moreover, higher fertility levels characterise every educational category. Consistently, the number of children ever born per 1,000 married women in the labour force is less than children ever born to women not in the labour force. It is interesting to note that the differentials are much larger for women who are university graduates than for less educated females, suggesting that career women limit their family size. At a national level, the fertility differential between female labour force participants and female non-participants is small, but working women have a fertility rate of 2,135 compared to 2,968 for non-working mothers. In summary, a complex set of factors associated with higher education and higher labour force participation rates contribute to the low fertility levels in Canada

2.4.7 Income from Wages and Salaries and Fertility

Another factor that influences the decision to enter the labour market is the market wage rate. At higher market wage rates, more women allocate more of their time to market related duties. Wages and salaries earned by married females by age is shown in Table 2.12. A large proportion of married females were earning less than $5,000 from wages and salaries in 1970. For this group, the fertility rate is 2,768, which is above the national average. The second income group $5,000 - 10,000, has the lowest birth rate. The association

TABLE 2.12

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING AGE GROUP AND INCOME FROM WAGES AND SALARIES ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

AGE GROUP	Income (from Wages and Salaries) Group							Number of Children Ever Born per 1000 Married Women
	Below $5,000	$5,000-10,000	$10,000-15,000	$15,000-20,000	$20,000-25,000	Above $25,000	Total	
15 - 19 years	702	9	0	0	0	0	711	586
20 - 24 "	4459	538	8	1	0	0	5006	882
25 - 29 "	5385	745	26	1	0	1	6158	1686
30 - 34 "	5097	447	33	3	1	0	5581	2626
35 - 39 "	4905	383	32	3	1	2	5326	3187
40 - 44 "	4778	394	33	4	1	3	5213	3372
45 - 49 "	4545	373	24	3	1	1	4947	3331
50 - 54 "	3886	297	26	3	3	0	4215	3170
55 - 59 "	3078	207	31	6	0	2	3324	3048
60 +	5742	128	16	3	2	4	5895	3266
Total	42577	3521	229	27	9	13	46376	
Number of Children Ever Born per 1000 Married Women	2768	1496	1790	1593	2111	2923		2666

betwen fertility and income from wages and salaries is not linear. The relationship between number of births and income group (income from wages and salaries) can be approximated by a U-shape curve with the exception of $10,000 - 15,000 income group (which is an outlier).

Income from wages and salaries varies according to education and other skills. According to Table 2.13, married women with different levels of education are classified according to income from wages and salaries. It is obvious that income from wages and salaries increases with education, for example, 55% of those married women earning between $5,000 and 10,000 have attained grades between 11 and 13. Similarly, 53% of married women earning between $10,000 and 15,000 have university degrees. Higher education tends to pay better wages and influence fertility through this path as well.

2.4.8 Income and Fertility

Total income is a different measure than income from wages and salaries. In Table 2.14 married females are classified according to income group and the level of education. It appears that higher income is associated with better education. The number of children ever born to married women according to income group and their labour force status are listed in Table 2.15. But married women that are in the labour force earning between $5,000 and 10,000 have the lowest fertility. In Table 2.16, these

TABLE 2.13

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LEVEL OF SCHOOLING AND INCOME FROM WAGES AND SALARIES ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LEVEL OF SCHOOLING	Income (from Wages and Salaries) Group							Number of Children Ever Born per 1000 Married Women
	Below $5,000 %	$5,000-10,000 %	$10,000-15,000 %	$15,000-20,000 %	$20,000-25,000 %	Above $25,000 %	Total	
Grade < 9	15556 36.5	297 8.4	11 4.8	3 11.1	2 22.2	4 30.8	15873 34.2	3431
Grades 9 - 10	10552 24.8	512 14.5	15 6.6	6 22.2	0 0	1 7.7	11086 23.9	2622
Grades 11 - 13	13907 32.7	1944 55.2	54 23.5	5 18.5	6 66.7	5 38.5	15921 34.3	2118
University No Degree	1679 3.2	484 13.7	29 12.7	0 0	0 0	0 0	2191 4.7	1969
University Degree	833 2.0	284 8.1	121 52.8	13 48.1	1 11.1	3 23.1	1305 2.8	1592
Total (100%)	42577	3521	229	27	9	13	46376	
Number of Children Ever Born per 1000 Married Women	2768	1496	1790	1593	2111	2923		2666

TABLE 2.14

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LEVEL OF SCHOOLING AND INCOME ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LEVEL OF SCHOOLING	INCOME GROUP							Number of Children Ever Born per 1000 Married Women
	Below $5,000 %	$5,000-10,000 %	$10,000-15,000 %	$15,000 20,000 %	$20,000-25,000 %	Above $25,000 %	Total %	
Grade < 9	15433 36.7	385 9.9	21 6.3	6 11.5	5 27.8	7 21.2	15857 34.2	3431
Grades 9 - 10	10442 24.9	586 15.1	35 10.4	10 19.2	1 5.6	2 6.1	11076 23.9	2622
Grades 11 - 13	13674 32.5	2081 53.7	107 31.9	19 36.5	9 50.0	16 48.5	15906 34.3	2118
University No Degree	1629 3.9	517 13.3	37 11.0	2 3.8	1 5.6	2 6.1	2188 4.7	1969
University Degree	841 2.0	306 7.9	135 40.2	15 28.8	2 11.2	6 18.1	1305 2.8	1592
Total (100%)	42019	3875	335	52	18	33	46376	
Number of Children Ever Born per 1000 Married Women	2776	1549	1815	2212	2056	2394		2666

TABLE 2.15

NUMBER OF CHILDREN EVER BORN TO MARRIED WOMEN OF AGE 15 YEARS AND OVER ALONG WITH LABOUR FORCE STATUS, CANADA, 1971

INCOME GROUP	NUMBER OF CHILDREN EVER BORN PER 1000 MARRIED WOMEN		
	Not in the Labour Force (64%)	In the Labour Force (34%)	Total (100%)
Below $5,000	2987	2304	2776
$5,000 - 10,000	1788	1519	1549
$10,000 - 15,000	2345	1704	1815
$15,000 - 20,000	1750	2350	2212
$20,000 - 25,000	2000	2083	2056
Above $25,000	3000	1947	2394
Total	2968	2133	2666

TABLE 2.16

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING AGE GROUP, INCOME GROUP, AND LABOUR FORCE STATUS

ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

AGE GROUP (YEARS)	NOT IN THE LABOUR FORCE							IN THE LABOUR FORCE						
	Below $5000	$5000 to 10000	$10000 to 15000	$15000 to 20000	$20000 to 25000	Abcve $25000	Total	Below $5000	$5000 to 10000	$10000 to 15000	$15000 to 20000	$20000 to 25000	Above $25000	Total
15-19	443	2	0	0	0	0	445	258	7	1	0	0	0	266
20-24	2455	54	1	0	0	0	2510	1978	503	13	1	0	1	2496
25-29	3642	92	10	3	0	2	3749	1699	680	28	0	0	1	2408
30-34	3517	45	2	1	0	0	3565	1535	427	41	3	1	1	2008
35-39	3212	33	4	0	2	1	3252	1644	382	35	5	0	3	2069
40-44	3025	32	3	2	0	2	3064	1696	399	36	4	4	3	2142
45-49	2932	34	5	1	1	2	2975	1535	386	36	5	1	2	1965
50-54	2558	30	8	2	1	1	2600	1257	311	26	10	3	2	1609
55-59	2210	30	9	0	0	1	2250	814	209	35	7	2	3	1070
60 +	5043	78	16	3	2	5	5147	566	141	26	5	1	1	742
Total	29037	430	58	12	6	14	29557	12982	3445	277	40	12	19	16775
Number of Children Ever Born per 1000 Married Women	2987	1788	2345	1750	2000	3000	2968	2304	1519	1704	2350	2083	1947	2133

married women are classified according to the age, income groups, and labour force status. It appears that the fertility rates, according to labour force status, are unrelated to income groups.

2.4.9 Family Income and Fertility

Traditionally, fertility differentials are attributed to family economic status. An ideal measure of family economic status is the family income. Family income includes income from all sources earned by all adult members of the family. Family income is determined by the female labour force participation rate, income from wages and salaries, and the level of education. According to the micro economic theory, the higher the family income the higher would be the demand for children. Thus, the family income affects fertility behaviour. Table 2.17 shows married women aged 15 years and over by level of schooling and family income groups along with number of children. Women with higher levels of education tend to have highly educated husbands and they belong to higher income brackets. There is a predictable association between family income and the number of children ever born per 1,000 married women belonging to that income group. Both the lowest and highest income groups have high fertility rates. The $10,000 - 15,000 income group has the lowest birth rate. The relationship between family income and fertility can be approximated by a U-shaped curve as depicted in Figure 2.1.

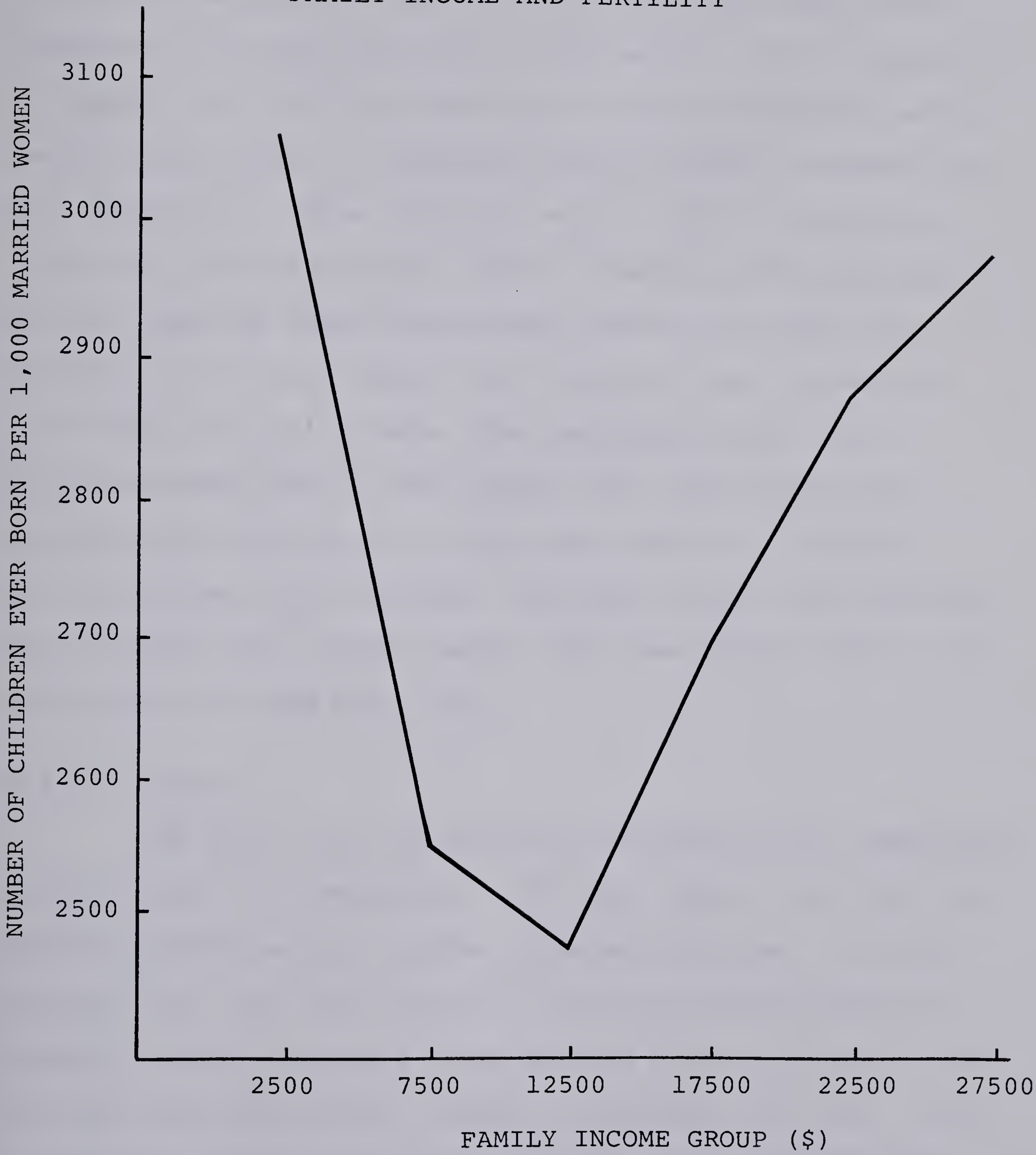
TABLE 2.17

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING LEVEL OF SCHOOLING AND FAMILY INCOME GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

LEVEL OF SCHOOLING	FAMILY INCOME GROUP							Number of Children Ever Born per 1000 Married Women
	Below $5,000	$5,000-10,000	$10,000-15,000	$15,000-20,000	$20,000-25,000	Above $25,000	Total	
Grade < 9	4884	6559	2878	786	230	190	15529	3431
Grades 9 - 10	1929	4824	2954	806	250	184	10943	2622
Grades 11 - 13	1795	5641	5194	1887	573	609	15699	2118
University No Degree	234	649	671	322	141	143	2160	1969
University Degree	104	218	357	264	129	213	1285	1592
Total	8942	17891	12054	4965	1323	1339	45614	
Number of Children Ever Born per 1000 Married Women	3049	2552	2481	2698	2875	2974		2666

FIGURE 2.1

FAMILY INCOME AND FERTILITY



2.4.10 Immigrants and Fertility

Canada is a vast country with various ethnic, cultural and religious groups. The Canadian population consists of immigrants from various parts of the world. It is interesting to compare the fertility behaviour of these immigrants with Canadian born women. Immigrants can be broadly grouped into two categories: those who came before 1946 and those who came after 1946 (but before 1971).[1] Table 2.18 summarizes married women by their immigration status and number of children ever born. Native born Canadian women appear to have higher fertility rates than immigrant women. The immigrant women have 2,360 children per 1,000 women ever married while the Canadian born women have 2,751 children per 1,000 women ever married. Collishaw (1976) also observed that migrants who arrived before 1946 have higher birth rates than those who came after 1946.

2.4.11 Summary

The PUST is a rich source of information for analysing Canadian fertility behaviour. The data reveal that there are fertility differentials across Canadian provinces. British Columbia has the lowest fertility rate and Newfoundland the highest. Among the age groups, married women between 40 and 44 years have the highest number of children ever born. This means that most Canadian women complete their childbearing

[1]In the PUST, period of immigration was recorded according to the year persons born outside of Canada first came to live in Canada before 1946 and later years.

TABLE 2.18

MARRIED WOMEN OF AGE 15 YEARS AND OVER SHOWING IMMIGRATION STATUS AND AGE GROUP ALONG WITH NUMBER OF CHILDREN EVER BORN, CANADA, 1971

IMMIGRATION STATUS	AGE GROUP IN YEARS											Number of Children Ever Born per 1000 Married Women
	15-19 %	20-24 %	25-29 %	30-34 %	35-39 %	40-44 %	45-49 %	50-54 %	55-59 %	60 + %	Total %	
Immigration	71	78	1182	1181	1186	1150	1158	804	602	1976	10091	2360
	10.0	15.6	19.2	21.2	22.3	22.1	23.4	19.1	18.1	33.5	21.8	
Before 1946	0	0	32	49	59	157	271	270	290	1538	2666	2823
After 1946	71	781	1150	1132	1127	993	887	534	312	438	7425	2196
Canadian Born	640	4225	4976	4400	4140	4063	3789	3411	2722	3919	36285	2751
	90.0	84.4	80.8	78.8	77.7	77.9	76.6	80.9	81.9	66.5	78.2	
Total	771	5006	6158	5581	5326	5213	4947	4215	3324	5895	46376	
Number of Children Ever Born per 1000 Married Women	586	882	1686	2626	3187	3372	3331	3170	3048	3266		2666

process by 44 years of age. Catholics have the highest fertility rates next to Hutterites and Mennonites. Jewish mothers have the lowest birth rates in Canada. It appears that investment in human capital in the form of increased female education limits family size, increases the labour force participation rate, and increases potential earnings in the form of wages and salaries. Career women have lower birth rates. It is observed that family income and fertility exhibit a non-linear relationship, represented by a U-shaped curve. Finally, immigrants tend to have lower birth rates than native born Canadians.

In this chapter, we have seen that a complex network of social and economic factors seem to affect fertility in Canada. The exact nature and size of these influences is unknown. The possibility of developing multivariate analysis with a view to quantifying the relative importance of different variables in explaining the changes in fertility has to be explored. The economic theory of household behaviour is a valuable tool for this task. Using the economic theory of fertility behaviour (Willis, 1973), demand relationships for children will be derived in the next chapter. Alternate specifications of fertility equations will then be suggested.

CHAPTER III

AN ECONOMIC MODEL OF FERTILITY

3.1 Introduction

In recent years, there have been several attempts to bring the determinants of fertility behaviour within the scope of economic analysis. In this chapter, a brief review of the literature leading to an economic framework of fertility behaviour is given. By applying the theory of consumer behaviour an economic model of fertility behaviour is presented. Three different specifications for estimating the demand for children are provided. In the end, a simultaneous equation model of fertility behaviour is explored.

3.2 Literature on the Economic Theory of Fertility

Since 1960, considerable progress has been made in explaining the fertility behaviour within an economic framework. Both theoretical and empirical studies have been done to identify the nature of socio-economic determinants of human reproductive behaviour.[1] Harvey Leibenstein and Gary Becker were the first to examine the usefulness of micro-economic theory for understanding fertility behaviour. A

[1] There are quite a few survey articles on fertility: Easterlin (1969), Schultz (1973), Fulop (1977), Sanderson (1976). Two special supplements of the Journal of Political Economy (March/April, 1973, 1974) were devoted to economic studies in fertility behaviour. A special issue of Social Forces (September,1975) discusses the fertility models.

summary of literature on the economic theory of fertility is provided here.

Leibenstein (1957) related economic development to the human reproductive behaviour. His socio-economic theory suggests that social and economic influences must be considered jointly in any fertility analysis. For example, economic changes influence the social status of families in which tastes for both children and other goods change. Leibenstein (1974, 1975) sketched a new theory of consumption based on social status considerations that are critical to the explanation of the utility cost of children. The population was divided into social status groups (or Social Influence Groups, SIGs) that have different tastes, different desires for children, and different cost structure including expenditure for children. He expected fertility to be positively related to income within the Social Influence Groups. Leibenstein's theory has certain shortcomings like, (i) no empirical support, (ii) no price effects, (iii) lack of predictive power, and (iv) the feedback between demographic and economic variables is not clear. Keeley (1975) criticised Leibenstein's approach, "built on many complex assumptions," as unstable and give no explanation why different SIGs have different tastes and has no predictive implications" (p. 467).

It is expected that demand for children depends on the tastes and preferences of parents along with family

income. According to Easterlin (1969),social determinants like "tastes" should be explicitly recognised in any economic model of fertility. Tastes are partly determined by income, and in turn affect potential income indirectly through choices made at any point in time. Income at one point in time may not be a valid representation of the income concept relevant to household decisions. In order to elucidate the secular behaviour of fertility Easterlin proposed two different theories of fertility namely, "the relative income hypothesis" and "the threshold of fertility regulations hypothesis." The relative income hypothesis is based on the intergenerational income namely, the relationship between income of young adults in the postwar period with the income of their parents in the thirties. He concludes that the severe financial constraints felt by young adults in the 1970s is responsible for the current fertility decline. With regard to the threshold of fertility regulations hypothesis,Fulop (1977) summarised Easterlin's work by saying that "as a country becomes more and more modernised, a threshold point is reached at which the loss in welfare due to unwanted children begins to exceed that associated with the cost of fertility regulations" (Fulop, 1977, p. 9). At this stage parents introduce fertility control and reduce the number of children born. It has also been suggested that the concept of child cost should account for opportunity cost of parents and other indirect costs incurred in childbearing and rearing. The immediate

determinants of the demand for children are income, the price of children relative to other goods, and subjective preferences for children compared with other goods. Easterlin (1975) assumed that the relative price of children and the relative price of goods consumed per child are independent of household decisions. This idea was rejected by Becker and Tomes (1976), who concluded that the expenditures per child and the other household decisions are not independent. In fact, the desired expenditure per child and parental income resulted in a positive relation and caused children to be more expensive for wealthier parents than for the poor parents.

From this discussion it appears that the theory of human reproductive behaviour has a close resemblance to the microeconomic theory of consumer behaviour. The economic model of fertility described above suggests that rational parents maximise certain utilities subject to the resource constraints. Becker (1960) pioneered in applying the theory of consumer durables to the demand for children. According to him, parents are assumed to maximise their satisfaction by choosing the number of children as well as other consumption goods. Children are treated as durable commodities but the demand for children is expressed more in terms of quality than quantity. Child services are assumed to be non-market commodities produced at home, with inputs of the wife's time and market goods according to the theory of allocation of

time (Becker, 1965). Michael and Becker (1973) combined the studies of Lancaster (1966) and Becker (1965) and suggested a new theory of consumer behaviour. They criticised the traditional consumer theory for its reliance on monetary factors. The demand for any commodity depends on both quality or attribute and the time it takes to consume. They reformulated the theory of consumer behaviour based on household production functions. The household production function approach incorporates the constraints of time, consumer knowledge and inter household differences in consumption efficiency into the theory of choice at a fundamental level.

Robert Willis (1973) incorporated the developments in consumer theory and the concept of household production function into a testable "new approach to the economic theory of fertility behaviour." He postulated that households maximize a utility function with children and other goods and services as arguments. The resource constraints include prices and costs of production of children. It is assumed that the family combines time supplied by family members with goods and services purchased in the market to produce the basic commodities within the household. The derived demand relations for children can be tested with the individual data on the number of children ever born. This is a one period static model in which the household is assumed to make all lifetime decisions at one point in time. The economic model of fertility presented in this chapter is a reformulation of

Willis' study.

The views expressed by both economists and demographers center around the economic framework of fertility behaviour. Namboodiri (1972) made the following observations on the economic framework for fertility analysis. He suggested several modifications to the economic model of fertility which will make it widely applicable in fertility research. For example, he reiterated Blake's (1968) question, are children really consumer durables? If the answer is yes then, why family members still go to have an additional child even when they feel that they cannot afford another? He explains this by saying that some people cannot see the implications of their actions over time. He suggests that the time orientation be explicitly included in the model. Namboodiri introduced the dynamic or sequential behaviour of fertility. According to him, "fertility decisions taken at different points in time and the success or failure in carrying out those decisions deserve to be considered as dependent variables in economic analysis" (p. 198).

3.3 Empirical Studies

There are several empirical studies coordinating the socio-economic determinants of fertility. First the Canadian experience with fertility analysis is explored. Later other empirical studies describing fertility will be discussed.

3.3.1 Canadian Studies

An economic interpretation of the Canadian fertility behaviour was attempted by Rao (1973). By developing a causal relationship between fertility and income in Canada, he analysed fertility trends across the country according to religious background and age. His findings, based on 1961 Canadian Census data, suggest that Quebec and Roman Catholics have the highest birth rates in Canada. He analysed both cross section and time series observations using a simple single equation model with birth rates as the dependent variable and per capita income as the independent variable. However, his study did not identify the nature and size of economic determinants of fertility behaviour in Canada. Denton and Spencer (1973a) analysed the effect of income on the levels of age specific fertility rates using the Gompertz function. They used a simulation "model to throw light on the consequences of connections between fertility levels and labour force participation of married women and between fertility levels and labour force participation on the one hand and income levels on the other" (p. 25). In a similar study, Denton and Spencer (1973b) introduced a theoretical model of an economic demographic system. Artificial but realistic values were assigned to the parameters and the simulated effect of particular types of demographic influences over time were studied. These models, however, lack economic interpretation and represent neither the Canadian

population nor the Canadian economy.

Madduri and Gupta (1974) studied Canadian birth rates in a simultaneous equation framework. This macro model has four endogenous variables namely, birth rates, per capita permanent income, female labour force participation rate, and infant mortality rate. The results of this time series study are not very satisfactory. The model faced many estimation problems. In a similar study,Madduri (1975) estimated a three equation model describing female labour participation rate in Canada. In this cross section study, female labour force participation rate, fertility rate, and female wage rate were the endogenous variables. This model was estimated with eleven observations on each variable corresponding to the ten provinces, and the Northwest Territories as one province. Because of the small sample size,the results of this study cannot be emphasized.

Beaujot, Krotki and Krishnan (1978) tested the socio-cultural variations in the applicability of the economic model of fertility. By using survey data from the Growth of Alberta Families Study, they found that the model is applicable in some socio-cultural circumstances but not in others. It appears that for "Other Western Group", utility considerations are central to fertility behaviour. For the French and the Ukrainian Groups, fertility may be controlled by institutional and normative pressures with little economic impact. In the five other ethnic groups ,the economic model is largely not supported.

3.3.2 Other Empirical Studies

Econometric analysis of fertility behaviour was attempted by Adelman (1963), Wilkinson (1973), and Venieris et al.(1973). In her cross country analysis, Adelman presented "an economic analysis of fertility and mortality patterns as they are affected by economic and social forms" (p. 314). Wilkinson provided an econometric analysis of fertility in Sweden during 1870-1965. In his time series study, the effect of economic constraints upon fertility according to the theory of household production and allocation of time was analysed. The dependent variable was the crude birth rate and the explanatory variables were the husband's earnings, the wife's potential earnings, the direct cost of children, the infant mortality rate and the immigration rate. A distributed lag model was introduced to describe the adjustment of fertility over time to changes in the several explanatory variables. Venieris et al. also did an econometric investigation relating to the demographic determinants of aggregate birth in the post war period in the United States. This model integrates the dynamic aspects of both demographic and economic mechanisms. The birth rate equation is specified with a lagged explanatory variable. The above mentioned studies are all macro studies explaining aggregate birth rates.

The economic analysis of fertility behaviour using the household production function and the theory of allocation

of time were attempted by Sanderson and Willis (1971), Gardner (1972), Cain and Weininger (1973), Willis (1973), De Tray (1973), Michael (1973), Schultz (1973), and Ben Poarth (1973). Sanderson and Willis (1971) estimated a linear model (a non-interaction and an interaction model). The regression equations were estimated with number of children ever born to married women as the dependent variable and the husband's income and wife's years of schooling as independent variables. They introduced wife's education as a proxy for her permanent market wage. They used individual records drawn from the U.S. 1960 Census one-in-one thousand sample. Gardner (1972, 1973) applied the economic theory of fertility formulated by Becker and Mincer (1963) to U.S. rural farm women and tested the rural - urban fertility differential. In his linear regression equation, the dependent variable was children ever born per 1,000 women aged 40 to 44 (a measure of realized family size) and the independent variables represented the opportunity cost (wife's wage rate) and income aspects of fertility (family income, schooling, percent non-white, age of males). He introduced family income to capture income effect through family's total earnings and other income. The regression coefficients were estimated with a cross section of 1960 U.S. Census. Cain and Weininger (1973) explained the "variations in rates of fertility among American wives in response to variations in female wages, income, and other variables" (p. 205). A

regression model was estimated with aggregate data on SMSAs in 1960. This is a single equation linear model with fertility (measured as the number of children ever born per 1,000 women ever married) as the dependent variable and male income, female full year earnings, female education, and other demographic variables as the independent variables. Female education was expected to measure the variations in birth control knowledge. Further Cain and Weininger attempted to capture the religious preferences by introducing a proxy variable (enrollment in private schools) in the regression equation.

In the new approach to the economic theory of fertility behaviour, Willis (1973) developed a mixture model and tested it with data on American families from the 1960 1/1,000 sample. He estimated an interaction model with the number of children ever born as the dependent variable and the wife's education, husband's earnings (Now and at Age 40) and other demographic variables as the independent variables. "The data consist of a sample of 9,169 white women aged 35-64 in 1960, married once, living with husband and living in urban areas at the time of 1960 census" (p. S49). De Tray (1973) was interested in the demand for child services. By creating a child quality variable (expected public school investment per child), he estimated two equations with the number of children and child quality as dependent variables. The independent variables were husband's and wife's education and their respective earnings, infant death rate and other

demographic variables. The regression sample consists of 555 counties randomly selected from the 1960 U.S. Census of population. He compared ordinary least squares estimates with two stage least squares estimates.

Robert Michael (1973) studied the relationship between education (a measure of human capital) and desired demand for CHILDREN. He observed a negative association between parent's education and the completed fertility. The inverse relation was interpreted in terms of differential knowledge or awareness of contraceptives among U.S. women. His empirical findings suggest a systematic selection of more effective contraceptives by more educated couples. By pooling time series and cross sectional data, Schultz (1973) explained the birth rate changes in a less developed country, Taiwan. The aim was "to specify a relation between birth rate the parents want and the price, income, information constraints that are not themselves determined simultaneously with, or subsequently by, the objective number of births" (p. S243). In his dynamic approach he specified a single reduced form equation with the birth rate as the dependent variable and the reciprocal of the child survival rate (return and price effects); the proportion of the male labour force employed in agricultue (relative price effect); male school attainment (income, price, and information effects); female school attainment (price, income, and information effects); and health and family planning field workers.

The data cover 361 administration regions of Taiwan from 1964 to 1969.

Ben Porath (1973) analyzed fertility behaviour in Israel through a single hypothesis based on links among education, the cost of time of women, and the full price of children. The emphasis was on the fertility relation with education. By using the data based on The Family Expenditure Survey of 1963/64, Ben Poarth estimated a fertility equation with the birth rate as the dependent variable and the wife's education, husband's education, husband's earnings, and other racial characteristics as the independent variables. He estimated a linear model and an interaction model. His study suggests that "the relation between fertility and education is steep at the very low levels of education and tends to flatten or even turn up at the top" (p. S204).

A simultaneous equation model of fertility behaviour was empiriracally tested by Hout (1978). The determinants of marital fertility in the United States were analyzed by a dynamic model with two endogenous variables, fetility and labour force participation. The fertility equation and labour force participation equations are functions of employment, duration of marriage, earning potential, birth cohorts, and husband's earning potential. The fertility variable was measured by the number of own children under two years old living with once married, spouse present women who were born between 1931 and 1951, and married before 1968. The labour

force participation was measured by scoring one for employed and zero for unemployed women at any time between January 1968 and April 1970. He estimated this simultaneous equation model with two stage least squares when one of the endogenous variables is dichotomous.[1]

Another simultaneous equation model of fertility, behaviour was developed by Gregory et al. (1973). They conducted a time series analysis of birth rates, labour force participation rate, per capita permanent income, and infant mortality rate as endogenous variables.

3.4 Economic Framework of Fertility Behaviour

In economic theory, the demand for any commodity is derived from the household utility function and a budget constraint with respect to prices and income. Following Willis (1973), the economic theory of fertility behaviour starts with the postulate that households maximize a utility function with children and other goods and services as arguments. The resource constraints include prices and costs of production of children. Demand for children or child services depends on parent's tastes and preferences. These preferences can be expressed by indifference curves.

It is assumed that the family combines time supplied by family members with goods and services purchased in the market to produce the basic commodities within the household.

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[1]Hout (1978) model is discussed further in Chapter V.

In the economic framework the characteristics of children that provide satisfaction to their parents as basic commodities are produced with time and goods according to household production functions. The amount of goods produced and consumed by the household depends on the quantities of time and purchased goods the household allocates to that production process, the state of consumption technology, and the efficiency with which the production process is undertaken. Inputs can be classified into three groups as male time, female time, and market goods and services.

Here children are one set of commodities included in the utility function that provide satisfaction to their parents. Children can be produced with time and goods according to household production functions. Specifically, the production function for child services can be written as,

$$C = f(t_c, x_c) \tag{3.1}$$

where t_c and x_c are respectively, vectors of purchased goods and family members' time devoted to child services. Parents derive satisfaction not only from child services but also from other goods and services. The other sources of satisfaction unrelated to child services can be expressed as a composite commodity S. This aggregate commodity is also produced according to a household production function like,

$$S = g(t_s, x_s) \tag{3.2}$$

where t_s and x_s are respectively, the vectors of time and goods devoted to S production. S embodies the standard of

living and all sources of satisfaction to parents other than those arising from their children. The properties of conventional production functions apply here. The family utility function can be more explicitly written as,

$$U = U(C,S) \tag{3.3}$$

This incorporates other sources of satisfaction as well as children to parents. The level of utility the family may achieve is limited by its capacity to produce C and S. The production capacity of the family is limited by its lifetime supplies of time and goods. To simplify the model, households are assumed to consist of a husband, a wife, and children only. Furthermore, it is assumed that in the household production process, (i) only the husband and wife contribute to market earnings, (ii) only the wife's time is productive at home and (iii) the structure of relative market prices remains constant. If p is the price index and x the aggregate input goods, then the family input of purchased goods is limited by its lifetime money income (or wealth) as,

$$Y = px \tag{3.4}$$

The money income is equal to the sum of its non labour wealth and the lifetime market earnings of the husband and wife. Since the husband is not productive at home, the sum of his lifetime market earnings and the family's non labour wealth will be the husband's lifetime income or wealth H, which is exogenous. The other factor that contributes to the family income is wife's market earnings which depends on her market

wage rate and the amount of labour time she allocates. The family's lifetime income and expenditure equation may be summarized as,

$$Y = H + wL = px \tag{3.5}$$

where w is the average market wage rate received by the wife and L the time she allocates to labour market during her marriage.

The amount of wife's time available for home production T, ($=t_c + t_s$, where t_c is the time allocated for children and t_s the time allocated for other goods) is equal to her life-span after marriage, T (which is exogenous), minus lifetime hours of market work L. Thus, the wife's time constraint is,

$$T = t + L \tag{3.6}$$

In the absence of joint production, it follows that a unit of goods or the wife's time devoted to C production must be subtracted from S production. So that

$$x = x_c + x_s \quad \text{and} \quad t = t_c + t_s = r_c x_c + r_s x_s \tag{3.7}$$

where x_c and t_c are inputs of goods and time assigned to children, x_s and t_s are inputs of goods and time assigned to S. $r_c = t_c/x_c$ and $r_s = t_s/x_s$ are respectively the time intensities of C and S production. The female wage rate can be determined by the amount of time she allocates to market work and the efficiency level or skills she possesses. Her average wage, w is determined by an earnings function of the form,

$$w = w(L,k) \tag{3.8}$$

where k is a shift or efficiency parameter which is assumed to increase with w. This earnings function may be regarded as a reduced form equation embodying the wife's accumulated human capital and her lifetime labour supply.

In summary, the family's capacity to obtain satisfaction from the number of children, C, and from the aggregate commodity, S, is limited by its consumption technology, endowments of wife's time and non-labour income, and the earnings of husband and wife. Family constraints on consumption and production of commodities can be written in implicit form as the production possibility function,

$$F(C,S,H,k,T)^{1} = 0 \tag{3.9}$$

This function implies that for preassigned levels of the endogenous variables H, k, and T and for a preassigned output level of S, the production possibility function gives the maximum attainable output for C.

The optimal allocation of resources determines a set of shadow prices which reflect the marginal opportunity cost of commodities and factors of consumption and production. The family's real "full wealth" in terms of shadow prices of commodities is,

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[1]Legend: H, husband's lifetime income; w, wife's market wage; L, wife's lifetime hours of market work or labour supply; t, wife's time available for home production; T, wife's life-span after marriage (t+L); Y, family's lifetime income (H+wL); k, efficiency parameter measuring wife's education or human capital.

$$I = h_c C + h_s S \tag{3.10}$$

where I is the full wealth and h_c and h_s are shadow prices of C and S.

The demand functions for child services, C, and the composite commodity, S, are derived by maximizing the family utility function (3.3) subject to full wealth constraint (3.10). In a conventional notation, the demand functions for C and S with parameters I, h_c and h_s can be written in the implicit form as,

$$C = C(I,h_c,h_s); \quad S = S(I,h_c,h_s) \tag{3.11}$$

The allocation of the wife's time between home production $t(=t_c + t_s)$ and market work $L(=T - t)$ depends on the opportunity cost of an additional hour of market work in terms of the value of home production foregone. Assume that the wife can supply an unlimited amount of market work at a constant wage rate w', and her price of time when she does no work $(L = 0)$ is w_o. If $w' < w_o$, it will be optimal for her to supply no market work, because the dollar value of commodity production sacrificed by withdrawing an hour of her time from direct input into home production exceeds the gain from the added goods input obtained from her additional market earnings. Similarly, if $w' > w_o$, it is optimal for her to supply labour to the market. She will do so until the added goods input obtained from her market work are reduced to the same level of dollar value of commodity input production at home.

The wife's lifetime market earning capacity depends on her initial stock of human capital at the outset of her marriage, k, and on the additional human capital accumulated during and after her marriage. Thus, her market earnings are an increasing function of her lifetime labour supply, L, so that her average lifetime earnings are wL = w(L,k)L, where w is her average lifetime wage which is a function of L and k.

The implicit production possibility function specified in equation (3.9) is determined by solving simultaneously the set of equations embodying the household production functions C and S, the time constraints, the wife's earnings function, the conditions for efficient allocation of time and goods within the home, and efficient allocation of the wife's time between home production and market work. If the value of the wife's time at home exceeds her marginal market wage rate so that she does no market work, the production function in the implicit form would be,

$$C = C(S,H,T) \tag{3.12}$$

If the wife's marginal market wage is sufficient to attract her to enter the labour market, the implicit production possibility function may be written as,

$$C = C(S,H,k,T) \tag{3.13}$$

The constraints on the family's production and consumption of commodities, whether the wife works in the market or not, may be written in a combined implicit production possibility function as,

$$0 = F(C,S,H,k,T) \begin{cases} = -C + C(S,H,T) & \text{wife doesn't work} \\ = -C + C(S,H,k,T) & \text{wife works} \end{cases} \quad (3.14)$$

Whether she participates in the labour force or not, the demand functions for children, can be derived by maximizing the family utility function (3.3) subject to the general production possibility constraint (3.14). For this mixed sample of households, the general fertility demand function with parameters H, k, and T can be derived as,

$$C = C(H,k,T) \quad (3.15)$$

A demand function when wife doesn't work,

$$C^0 = C^0(H,T)$$

and when wife does work, $C^1 = C^1(H,k,T)$ (3.16)

A similar demand function for S can also be derived.

In order to investigate its properties, the fertility demand function is reformulated more suitably for empirical analysis. A population may consist of both working and non working mothers. If the data on a sample of families contain both working and non working mothers, it is simpler to consider the relationship between C and the exogenous variables H, k, and T that would be expected on the basis of the model of individual fertility behaviour in (3.16). Let $\bar{R}$ be the proportion of married women in the labour force equivalent to the average lifetime labour force participation rate of married women and $1 - \bar{R}$, the complement of $\bar{R}$. It can be noticed that $\bar{R}$ itself is a function of H, k, and T. The general fertility demand function may be written as a mixture

of the two special demand functions as,

$$C = C(H,k,T) = \bar{R}\ C^{1}(H,k,T) + (1 - \bar{R})\ C^{0}(H,T) + u \quad (3.17)$$

where u is a random disturbance term. It is assumed that variations in the parameters of the structural equations for the model among families in the population are such that u is normally distributed with mean zero and constant variance and is independent of the expogenous variables.

The functional form, equation (3.17), cannot be estimated in that form. One way to obtain a relationship that can be estimated is to take a Taylor series expansion of (3.17) about the mean values of H and k and then estimate the coefficients of the resulting polynomial in H and k as an approximation of (3.17). The fertility demand function from the mixture model can be approximated as,

$$C = d_0 + d_1H + d_2k + d_3Hk + d_4H^2 + d_5k^2 \quad (3.18)$$

In this form, the signs of the coeffecents d_1 and d_2 are difficult to be predicted because they are functions of H, k, and T.[1] The signs of the coefficients of the squared terms d_4 and d_5, and the interaction term d_3, reflect the differential impact of variations in H and k on the opportunity cost of children between families in which the wife

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[1]If we consider each of the constituent functions of (3.17), (i.e., $\bar{R}$, C^0, and C^1) to be polynomials of dregree r, the mixture function will be a polynomial of degree r whose coefficients will be functions of the coefficients of the constituent functions. In the simplest case the functions can be written in linear form as,
$C^0(H) = a_0+a_1H$; $C^1(H,k) = b_0+b_1H+b_2k$; $\bar{R}(H,k) = c_0+c_1H+c_2k$.
The coefficients of the first degree terms, d_1 and d_2 involve a_0,b_0, and c_0 whose signs are not predicted by theory.

works and families in which the wife doesn't work.[1] This also reflects changes in the proportion of two types of families caused by variations in H and k on the labour force participation of married women. The non-linearity of the mixture model implies that the effects of changing income and female wage rates on fertility behaviour will vary in strength and even in sign with the prevailing levels of income and wages. This implication is consistent with the ambiguous income-fertility relationship noted in fertility studies. Willis (1973) tested this mixture model in the simple form called "interaction model."

$$C = d_0' + d_1'H + d_2'k + d_3'Hk + u \qquad (3.19)$$

Based on the economic literature, it is expected that $d_1' < 0$, $d_2' < 0$, and $d_3' > 0$ and that the interaction model would help to explain the U-shaped relationship between fertility and husband's lifetime earnings or family income.[2] From equation

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[1]Ben-Porath (1973) argues that, "the simple linear model applies to households where the wife plans to work part of her lifetime. Only then is the market wage rate (or education as an indication of market productivity) a correct measure of what she is foregoing by devoting time to her children. Women who don't plan to work at all presumably have a non-market evaluation of their time higher than the market wage. Variations in the potential market wage for such women do not correspond to variations (over individuals or over time) in the marginal value of time. But higher full income of household, by increasing the demands on women's time in all household uses, raises the shadow price of this fixed constraint and gives rise to substitution effect away from children. Therefore, one would expect husband's higher earnings to be associated with higher probability of the wife being a permanent non-participant in the labour force" (p. S219).

[2]The correlation between family income (proxy for H) and the wife's education (proxy for k) is 0.31. An attempt was made to estimate both equations (3.18) and (3.19). But in the estimated equation (3.18), the coefficients of H^2 and

(3.19) the respective partial derivatives are,

$$\frac{\partial C}{\partial H} = d_1' + d'k; \; \frac{\partial C}{\partial k} = d_2' + d_3'H \qquad (3.20)$$

In interpreting the findings, one should distinguish between the estimated equation and the hypothesis behind it. The estimating equation under the present conditions may be an expression of the non-linear form (3.18). In that case, the partial derivative is,

$$\frac{\partial C}{\partial H} = d_1 + d_3k + 2d_4H.$$

If one starts by assuming a linear function relating fertility to the relevant variables among working and non-working women and also relating the probability of work to relevant variables, a quadratic expression emerges. One would assume that the resulting collinearity would make full estimation impossible. But one should interpret the coefficients of the interaction model as resulting from an estimation where some relevant variables were left out. The interaction regression derived from the general mixture model is capturing mostly a curvilinear association of fertility with the wife's education which is independent of the effect of husband's earnings.

3.5 Specification of an Economic Model of Fertility

According to equations (3.15) and (3.19) the demand

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k^2 are not statistically significant. So the results of (3.18) are not reported here. Ben Poarth (1973) suggests that if the correlation between H and k is positive and high (but not too high), the interaction term Hk acts as a proxy for k^2 (p. S220).

for children is an implicit function of husband's earnings H, the wife's life-span T, and an efficiency parameter k. The wife can assign her lifetime T, after marriage either to market or non-market work. The lifetime after marriage is determined by her age at first marriage. The allocation of time to market work depends on the existing market wage rate which is determined by the efficiency parameter. The efficiency parameter is measured in terms of the wife's education and skills. According to relevant literature, religious affiliations play a significant role in a woman's choice of birth control and other contraceptives. The religious affiliations are captured by a dummy variable (for Catholics) in the fertility equation. It can be generalized that the human reproductive behaviour can be expressed as a function of the husband's earnings and the wife's wage rate, labour force status, level of education, age at first marriage, and religious affiliations.[1] The model in general terms is

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[1]For example, infant mortality is one of the important determinants of fertility behaviour. It has been suggested by Ben Poarth (1973) that the reaction to child mortality can be summarized into two categories: "hoarding" and "replacement." Hoarding would be the response of fertility to expected mortality of offspring. Replacement would be the response to experienced child mortality. Schultz (1969, 1973, 1975), Schultz and DaVanzo (1970), and O'Hara (1972) have investigated the association of infant mortality and fertility behaviour. Williams (1977) analysed the impact of child mortality on fertility using a sequential model. But, such an association could not be tested here due to lack of data on infant death rates in the PUST data source. One can counter argue that infant mortality is more significant for less developed countries rather than for industrialized societies like Canada.

specified as,

FERTILITY = f(LABFORCE, INCOME, SCHOOL, CATHOLIC, AGFTMAR)

FERTILITY = birth rate measured by the number of children ever born per 1,000 married women (CHILDREN) or family size (FAMSIZE)

INCOME = income measured by family income (FAMINC) or wife's income from wages and salaries (INCWAGES)

LABFORCE = labour force status, measured either by a dichotomous variable such as, wife worked or not (WORKER), or by number of weeks she worked (WEEKS)

SCHOOL = wife's level of school, measured by the number of years of schooling from 0 - 20.

CATHOLIC = religious affiliation, measured by wife belonging to Roman Catholic Church

AGEFTMAR = wife's age at first marriage.

The relevance of these variables in the Canadian context is evident from chapter II. For example, the number of children ever born per 1,000 married women is inversely associated to the level of schooling of Canadian mothers. Similarly, the number of children born to married women participating in the labour force is smaller than those that do not participate in the labour force. A large number of Canadian women belong to the Roman Catholic Church and they have the second largest number of children. Also, early married women tend to have a large number of children. In the case of income, either measured as family income or

income from wages and salaries, the number of children ever born per 1,000 married women has a peculiar association with the income variable.

The above model is tested empirically in two parts namely, Single Equation Model and Simultaneous Equation Model. The Single Equation Model is estimated by (i) a linear model, (ii) an interaction model, and (iii) a non-linear model.

3.5.1 Single Equation Models

(i) Linear Model:

$$\text{FERTILITY} = a_0 + a_1\text{LABFORCE} + a_2\text{INCOME} + a_3\text{SCHOOL} + a_4\text{CATHOLIC} + a_5\text{AGEFTMAR} + u_a$$

The fertility equation tested is of the form,

$$\text{CHILDREN/FAMSIZE} = a_0 + a_1\text{WORKER/WEEKS} + a_2\text{FAMINC/INCWAGES} + a_3\text{SCHOOL} + a_4\text{CATHOLIC} + a_5\text{AGEFTMAR} + u_a$$

(ii) Interaction Model:

$$\text{FERTILITY} = b_0 + b_1\text{LABFORCE} + b_2\text{INCOME} + b_3(\text{INCOME*SCHOOL}) + b_4\text{SCHOOL} + b_5\text{CATHOLIC} + b_6\text{AGFTMAR} + u_b$$

The fertility equation tested is of the form,

$$\text{CHILDREN/FAMSIZE} = b_0 + b_1\text{WORKER/WEEKS} + b_2\text{FAMINC} + b_3(\text{FAMINC*SCHOOL}) + b_4\text{SCHOOL} + b_5\text{CATHOLIC} + b_6\text{AGEFTMAR} + u_b$$

(iii) Non-Linear Model:

$$\text{FERTILITY} = d_0(\text{INCOME})^{d_1} \ \text{Exp.}\ (d_2\text{LABFORCE} + d_3\text{SCHOOL} + d_4\text{CATHOLIC} + d_5\text{AGEFTMAR}) \cdot u_d$$

The fertility equation tested is of the form,

$$\text{Log(FAMSIZE)} = c_0 + c_1\text{Log(FAMINC)} + c_2\text{WORKER/WEEKS} + c_3\text{SCHOOL} + c_4\text{CATHOLIC} + c_5\text{AGEFTMAR} + u_c^1$$

3.5.2 Simultaneous Equation Model

Recently, it has been suggested that some factors affecting fertility are jointly determined with fertility (Nerlove and Schultz, 1970). Mincer (1963) noted that the relation between fertility and income is not autonomous. According to Okun (1965) the level of per capita income affects the birth rates, and birth rates and participation rates in turn determine the per capita income. Reference has already been made to some of the simultaneous equation studies of fertility.

This study attempted to incorporate the causal effects of fertility on married female labour force participation rate and vice versa. When labour force status is expressed as a dichotomous variable such as, whether the wife worked or not, there are certain estimation problems.[2] Therefore, the labour force participation equation with the number of weeks worked as the dependent variable has been attempted here. In deriving the labour force equation, the

[1] u_a, u_b, and u_c are random disturbance terms. These random variables are assumed to be normally distributed with mean zero and constant variance and independent of explanatory variables, even though normality assumption is not essential for estimation purposes.

[2] The use of dichotomous endogeneous variables limits the efficiency of 2SLS. Significant tests using standard errors computed in the usual way would be invalid (Schmidt and Strauss, 1975).

existing literature in Canadian married female labour supply equations has been consulted. There are several Canadian studies explaining female labour force participation behaviour with fertility as one of the explanatory variables. For example, Swan (1974) explained the Canadian labour supply with fertility as an explanatory variable. Other studies of this nature include Allingham (1967, 1968), Officer and Anderson (1969), Ostry (1968a, 1968b, 1968c), Spencer (1973), Spencer and Featherstone (1970), Swidinsky (1970), and DeCore (1976). Skoulas (1974) studied the determinants of participation rates of married women in the Canadian labour force. In all these studies, fertility is a significant factor determining female labour force behaviour.

In a simultaneous equation framework, the fertility equation and female labour force equation are specified as follows.

$$\begin{aligned} \text{FERTILITY} = d_0 &+ d_1\text{WEEKS} + d_2\text{INCOME} + d_3\text{SCHOOL} + d_4\text{CATHOLIC} \\ &+ d_5\text{AGEFTMAR} + u_d \end{aligned}$$

$$\begin{aligned} \text{WEEKS}^{2} = e_0 &+ e_1\text{FERTILITY} + e_2\text{INCWAGES} + e_3\text{SCHOOL} + e_4\text{IMIGRANT} \\ &+ e_5\text{TECHNIC} + e_6\text{FAMINC} + u_e \end{aligned}$$

where u_d and u_e are random disturbances normally distributed with mean zero and constant variance.

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[1]The variable TECHNIC is introduced in order to capture the effect of additional technical and other skills on the labour force activity. Similarly the IMIGRANT variable would explain the difference between Canadian born and immigrant workers.

In this two equation model, FERTILITY and WEEKS are the endogeneous variables and FAMINC, INCWAGES, SCHOOL, CATHOLIC, AGEFTMAR, IMIGRANT, and TECHNIC are the exogeneous variables. Each of the behaviour equation satisfies the criteria for identification (over identified). The two stage least squares method of estimation yields consistent estimators.

The behavioural equations tested by this simultaneous equation model are,

$$\text{CHILDREN/FAMSIZE} = d_0 + d_1\text{WEEKS} + d_2\text{FAMINC/INCWAGES} + d_3\text{SCHOOL} + d_4\text{CATHOLIC} + d_5\text{AGEFTMAR} + u_d$$

$$\text{WEEKS}^1 = e_0 + e_1\text{CHILDREN/FAMSIZE} + e_2\text{INCWAGES} + e_3\text{SCHOOL} + e_4\text{IMIGRANT} + e_5\text{TECHNIC} + e_6\text{FAMINC} + u_e$$

Empirical results are presented in the following chapter.

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[1]The WORKER equation was also estimated with two stages least squares method. Since this is not a proper method of estimation for a dichotomous endogeneous variable, the results are reported in the Appendix.

CHAPTER IV

ECONOMIC MODEL OF CANADIAN FERTILITY: EMPIRICAL RESULTS

4.1 Introduction

The main features of Canadian fertility were described with the aid of tabular analysis. In chapter III economic models of fertility were specified. In this chapter we explore these models through quantitative analysis.

In the next section of this chapter, the sample data used for this investigation is discussed. In section 4.3 the estimated coefficients of fertility models are analyzed. Finally, in section 4.4, the results are summarized.

4.2 Sample Data

Information from the 1971 Census of Canada was used in the economic anlaysis of fertility. A one percent sample of Census data was stored as Public Use Sample Tape, PUST. By systematic sampling method, a one percent sample of individual records from PUST was selected for this study. From a total of 46,376 individual records in PUST, the one percent sample provided 464 observations. In general, one individual record was selected for every 10,000 records in the 1971 data. The unit of measurement here is the individual married woman.

In Table 4.1, the variable name, mean and standard deviation along with income groups are reported. Three

TABLE 4.1

SUMMARY STATISTICS OF A SAMPLE OF MARRIED WOMEN OF AGE 15 YEARS AND OVER,

1971 CENSUS, 1/10,000 SAMPLE

VARIABLE NAME	TOTAL		LOW INCOME < $5000		MIDDLE INCOME $5,000-15,000		HIGH INCOME > $15,000	
	MEAN	S.D	MEAN	S.D	MEAN	S.D	MEAN	S.D
Number of Children Ever Born (CHILDREN)	2.7349	2.4497	3.1333	2.9703	2.5739	2.2569	2.7000	2.1017
Family size (FAMSIZE)	3.7177	1.6679	3.3500	1.7853	3.7923	1.5555	3.1000	1.8291
Labour Force Status (WORKER)	0.3039	0.4604	0.2000	0.4017	0.3345	0.4727	0.3667	0.4860
Number of Weeks Worked (WEEKS)	14.4461	20.8435	9.4167	18.0208	15.7218	21.2238	18.4667	22.7592
Level of Schooling (SCHOOL)	10.2026	2.2942	9.2583	2.3064	10.3169	2.1130	11.5500	2.3320
Income from Wages and Salaries (INCWAGES)	1025.0400	1956.9402	339.9167	960.6593	1097.8838	1852.2211	2050.5000	3112.2167
Family Income (FAMINC)	9439.1160	6712.2420	3068.7500	1389.8500	9380.2820	2501.4520	22458.3300	8045.0490
Age at First Marriage (AGEFTMAR)	22.6121	5.5134	21.7917	5.3655	22.8275	5.7873	23.2333	4.2241
Technical Training (TECHNIC)	0.1099	0.3131	0.0333	0.1803	0.1232	0.3293	0.2000	0.4034
Religion (CATHOLIC)	0.4418	0.4971	.5083	0.5020	0.4190	0.4943	0.4167	0.4972
Immigration Status (IMIGRANT)	0.2026	0.4024	0.2500	0.4348	0.1690	0.3754	0.2667	0.4459
Number of Observations	464		120		284		60	

family income groups were selected to investigate the differential fertility behaviour. The three family groups are: low, with a family income of less than $5,000; middle, with family income between $5,000 and $15,000; high, family income larger than $15,000. (It is felt that these three income groups represent the economic status in 1970). Among the total number of observations, the low income group has 120, the medium income group has 284, the high income group has 60. The average number of children ever born for married females is 2.7, but for the low income category it is 3.1. The average family size is 3.7, but is highest for the middle income group which is 3.8. On the average 30.4 percent of married women were in the labour force. This rate is highest for the higher income groups. Similarly, the average number of weeks worked in 1970 by the married women is the highest for the high income group. Both labour force participation and weeks worked show considerable variation as indicated by the large standard deviations. The mean years of schooling is 10 years, indicating that most of the married women have achieved junior high school education. Higher education standards are associated with high income families. The married woman's average annual income from wages and salaries is $2,050 for the high income group. It was $1,025 for Canada. Similar patterns are noticed with respect to family income. However, these two variables have

large standard deviations. The average age at marriage is 22.6 years while low income families tend to marry early at the age of 21.8 years. About 20 percent of the married females that belong to high income group have some kind of technical skills, compared to the national average of 11 percent. From this sample of observations, 51 percent of married women that are Catholic are from low income families while, at a national level, about 44 percent are Catholic. A majority of immigrants belong to either low income or high income families.

In order to identify the significance and appropriateness of these variables for this study, a simple correlation coefficient between these variables is presented in Table 4.2. The highest correlation coefficient of 0.75 is measured between WEEKS, the number of weeks worked and WORKER, the labour force participation of married women. This is not unexpected because the two variables measure the same economic activity of married women. Similarly, the more the duration of work the higher will be the income from wages and salaries. The correlation between WEEKS and INCWAGES is the next highest, 0.73. Since the labour force participation is another measure of weeks worked, the correlation coefficient between WORKER and INCWAGES is also very high, in the order of 0.62. Two variables that are used as proxies for fertility are CHILDREN and FAMSIZE. The number of children ever born and the size of the family have a positive measure

TABLE 4.2

SIMPLE CORRELATION MATRIX

VARIABLES	CHILDREN	FAMSIZE	WORKER	WEEKS	SCHOOL	INCWAGES	FAMINC	AGEFTMAR	TECHNIC	CATHOLIC	IMIGRANT	MEAN
CHILDREN	1.00000	0.51449	-0.21375	-0.18892	0.19350	-0.22859	-0.00870	-0.19569	-0.06049	0.20811	-0.05934	2.7349
FAMSIZE	0.51449	1.00000	-0.13273	-0.19503	-0.02566	-0.17790	0.18998	-0.19490	0.02233	0.15336	-0.12700	2.7177
WORKER	-0.21375	-0.13273	1.00000	0.75103	0.19718	0.62088	0.07326	-0.02153	0.14235	-0.00279	0.05171	0.3039
WEEKS	-0.18892	-0.10503	0.75103	1.00000	0.19350	0.72748	0.10961	-0.04354	0.16191	-0.03615	0.00645	14.4461
SCHOOL	0.19350	-0.02566	0.19718	0.19350	1.00000	0.33556	0.30691	0.12814	0.18541	-0.21499	0.00224	10.2026
INCWAGES	-0.22859	-0.17790	0.62088	0.72748	0.33556	1.00000	0.23842	0.03431	0.14220	-0.05207	-0.00034	1025.0409
FAMINC	-0.00870	0.18998	0.07326	0.10961	0.30691	0.23842	1.00000	0.05600	0.12779	-0.02881	0.01657	9439.1160
AGEFTMAR	-0.19569	-0.19490	-0.02153	-0.04354	0.12814	0.03431	0.05600	1.00000	-0.00527	-0.03889	0.14455	22.6121
TECHNIC	-0.06049	0.02233	0.14235	0.16191	0.18541	0.14220	0.12779	-0.00527	1.00000	-0.00739	-0.00569	0.1099
CATHOLIC	0.20811	0.15336	-0.00279	-0.03615	-0.21499	-0.05207	-0.02881	-0.03899	-0.00739	1.00000	-0.11370	0.4418
IMIGRANT	-0.05934	-0.12700	0.05171	0.00645	0.00224	-0.00034	0.01657	0.14455	-0.00569	-0.11370	1.00000	0.2026

of correlation equivalent to 0.51. The estimated correlation coefficients among other variables are small but not negligible. For example, level of education is associated with higher earnings from wages and salaries. The correlation between INCWAGES and SCHOOL is 0.34. In general, the lowest correlation is noticed for immigrants with all the variables. The direction of association confirms the expected causality between the variables.

In this dissertation, fertility rate is defined as the number of children ever born per 1,000 married women aged 15 years and over. In certain studies of fertility behaviour, family size is taken as a measure of fertility (Gardner, 1973). The important distinction between the two variables is that CHILDREN, the number of children ever born, includes only those born alive, whether born of the present marriage or any previous marriage. This includes children who died after birth as well as those residing elsewhere at census time, but excludes adopted and step children. Family size includes all the children who have never married living within the household, adopted children and step children. But it does not account for children never married but living outside the household. Both variables are measures of fertility in their own way. Here the analysis is carried out using both these variables as measures of fertility. Similarly, WORKER and WEEKS variable are used independently to represent the labour force status of married women (it was

noted earlier that the correlation coefficient between these two variables is the highest). In summary the fertility behaviour of Canadian married women is analysed with CHILDREN and FAMSIZE as dependent variables, and WORKER and WEEKS as independent variables along with other variables as specified in the regression specification.

4.3 Results from Regression Analysis

The fertility model specified in the previous chapter is estimated and the regression results are presented below. The single equation model was estimated by ordinary least square method and the simultaneous equation model was estimated by two stage least squares method. In order to detect the structural changes in fertility, the fertility model was estimated for the total and for each of the three income groups. Any significant differences in income groups were examined by a test of linear restrictions (Riddell, 1978).[1] The resulting F statistics are reported in Table 4.13.

One of the assumptions of multiple regression was

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[1]A test of linear restrictions or equality of parameter vectors across income groups is,

$$F = \frac{\hat{S}(T) - [\hat{S}(T_1) + \hat{S}(T_2) + \hat{S}(T_3)]}{[\hat{S}(T_1) + \hat{S}(T_2) + \hat{S}(T_3)]} \; \frac{T - 3k}{2k}$$

where $S(\hat{T})$ is the restricted sum of squared residuals based on full sample, and $S(\hat{T}_1)$, $S(\hat{T}_2)$ and $S(\hat{T}_3)$ are unrestricted sum of squared residuals based on low, medium, and high income groups. T is the total number of observations and k is the number of independent variables in the equation. Under the null hypothesis that there is no difference between the income groups, F-statistic is distributed with 2k and T - 3k degrees of freedom.

that the variance of the error term, u is constant for all possible sets of independent variables. But there is scant empirical evidence on the likely type of heteroscedasticity in economic relationships. In fertility studies the residual variance about the regression function may very likely increase with income. In order to check for possible heteroscedasticity the Goldfield-Quandt test was conducted (Johnston, 1972, p. 219).[1] This test revealed that there is no heteroscedasticity among the residual variances with respect to income groups.

4.3.1 Estimated Linear Model

As stated earlier the linear model is estimated with CHILDREN and FAMSIZE as alternate variables. The estimated coefficients with CHILDREN as the dependent variable are reported in Table 4.3. Fertility is directly related to family income and religion whereas it is inversely related to the mother's labour force activity, level of education, and age at marriage. This can be summarized by saying that price effect dominates income effect. Low income group is not satisfactorily represented by this relationship. In the middle income class, WEEKS or WORKER, SCHOOL, CATHOLIC, and AGEFTMAR

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[1]Goldfield-Quandt test for heteroscedasticity is $R = S_h/S_\ell$, where S_ℓ is the sum of the squared residuals from the low income group and S_h is the sum of the squared residuals from high income groups. Under the null hypothesis of homoscedasticity, R will have the F distribution with $((n-c-2k)/2,\ (n-c-2k)/2)$ degrees of freedom. n is the total number of observations, c is the number of observations (excluded group) in the medium income group, and k the number of parameters to be estimated. In all cases the estimated value of R is between 0.21 and 0.67 which suggests no heteroscedasticity.

TABLE 4.3

FERTILITY EQUATION, LINEAR MODEL

Dependent Variable: CHILDREN (number of children ever born)

INCOME GROUP	WEEKS	WORKER	INCWAGES $000	FAMINC $000	SCHOOL	CATHOLIC	AGEFTMAR	CONSTANT	R^2	SEE
Total	-0.01065 (1.4)		-0.11844 (1.4)		-0.17173* (3.4)	0.78208* (3.6)	-0.07535* (3.9)	6.12061* (9.2)	0.1477	2.2738
	-0.01888* (3.6)			0.03151* (1.9)	-0.21986* (4.3)	0.75733* (3.5)	-0.07782* (4.0)	6.37831* (9.9)	0.1506	2.2700
		-0.74173* (2.5)	-0.09417 (1.3)		-0.16692* (3.3)	0.80604* (3.7)	-0.07540* (3.9)	6.10866* (9.3)	0.1558	2.2630
		-0.97848* (4.2)		0.02908** (1.8)	-0.21089* (4.2)	0.79188* (3.7)	-0.07666 (4.0)	6.29295* (9.8)	0.1584	2.2596
Low < $5000	-0.01411 (0.8)		-0.26054 (0.7)		-0.31659* (0.1)	0.22933 (0.4)	-0.07695** (1.7)	7.81310	0.1439	2.6713
	-0.02617** (1.8)			-0.02707 (0.1)	-0.39445* (3.4)	0.10800 (0.2)	-0.05713 (1.2)	8.30490	0.1433	2.8090
		-0.90418 (1.2)	-0.26298 (0.8)		-0.25854* (2.1)	0.25725 (0.5)	-0.07814** (1.7)	7.33333	0.1502	2.6617
		-1.30091** (1.9)		-0.03857 (0.2)	-0.31820* (2.6)	0.18808 (0.4)	-0.05826 (1.2)	7.63208	0.1454	2.8055
Medium $5000-15000	0.00260 (0.3)		-0.28894* (2.6)		-0.09049 (1.4)	0.92018* (3.6)	-0.07736* (3.6)	5.16416	0.1617	2.0849
	-0.01565* (2.6)			-0.01706 (0.3)	-0.12180** (1.9)	0.90825* (3.5)	-0.07954* (3.6)	5.67186	0.1394	2.1124
		-0.29663 (0.9)	-0.21817* (2.4)		-0.09466** (1.5)	0.93939* (3.6)	-0.07823* (3.6)	5.28200	0.1638	2.0822
		-0.79505* (3.0)		-0.02044 (0.4)	-0.13117* (2.1)	0.94982* (3.6)	-0.07718* (3.5)	5.74864	0.1460	2.1043
High > $15000	-0.05024* (2.3)		0.18277 (1.1)		-0.27372* (2.3)	1.05829** (1.9)	-0.05051 (0.7)	7.12302	0.25175	2.2754
	-0.02158* (2.1)			0.08147* (2.8)	-0.17441* (16.5)	0.95133* (2.1)	-0.10636** (1.8)	5.35809	0.3828	1.7258
		-2.0741* (2.1)	0.14087 (0.8)		-0.28685* (12.7)	0.92515** (1.6)	-0.06259 (0.8)	7.53620	0.2421	2.2900
		-0.9341** (1.9)		0.08152* (2.7)	-0.18229** (1.7)	0.88591** (1.9)	-0.11437* (2.0)	5.60532	0.3755	1.7361

*Significant at 5% level
**Significant at 10% level

Total Number of Observations 464
Ordinary Least Squares Estimation

Parentheses Values are t-Statistics

have expected signs and significant. In the equation with WEEKS and INCWAGES variables, WEEKS is not significant. Family income, FAMINC, has a negative sign but it is not significant. The alternate income variable, INCWAGES, has a negative sign and is significant. For the high income group, most of the coefficients have acceptable signs and are significant. This group has the highest R^2. It appears that higher income families are more sensitive to socio-economic factors than in other income groups.

The effect of family income on fertility, according to the results of these regressions, appears to have changed from negative to positive signs across successive income groups. The coefficient of SCHOOL, the wife's years of education, is always negative and statistically significant.

There is a positive income effect for the overall and high income categories. The negative income effect for the low and middle income groups implies a strong substitution effect. This is consistent with the theory that marginal income is important for less than high income families. The effect of wife's earnings is negative for all but high income category. This implies that the INCWAGES variable acts as a price variable and a deterrent to fertility. Economic considerations are thus strong determinants of fertility.

From the estimated coefficients it appears that there is some variation between the income groups. But according to the F-test (Table 4.13) such a variability is not statistically significant. However, the parameters differ between the income levels. One logical observation would be a

non-linear fertility-income relationship. For the total income, it is positive, and for the low and medium income families, negative. It reversed its direction for the high income group. The labour force status measured either by WEEKS or by WORKER reduces the number of children ever born. Education played a more significant role for the low and high income groups than for middle income families. Religious affiliations are not important for the low income families but they are for the middle and high income groups. Age at marriage is significant in all cases.

The computed elasticities of demand for children with respect to the exogeneous variables in the linear model are reported in Table 4.4. The income elasticity of fertility in all cases is small. When income is measured as the income from wages and salaries, the income elasticity is negative in all but high income group. The price elasticity measured with respect to level of schooling is consistently negative and larger than income elasticity in magnitude. This confirms Becker's (1960) conjecture that price elasticity is larger than income elasticity in absolute value. The elasticity of fertility with repsect to labour force status is negative but small. The age at marriage has a large negative elasticity.

The estimated coefficients with FAMSIZE as a dependent variable are reported in Table 4.5. Family size is directly related to family income and is significant. The other

TABLE 4.4

ESTIMATED ELASTICITIES, LINEAR MODEL

Dependent Variable: CHILDREN (number of children ever born)

INCOME GROUP	WEEKS	WORKER	INCWAGES	FAMINC	SCHOOL	CATHOLIC	AGEFTMAR
Total Income	-0.0557		-0.0444		-0.6406	0.1263	-0.6147
	-0.0997			0.1088	-0.8202	0.1223	-0.6434
		-0.0824	-0.0853		-0.6227	0.1302	-0.6234
		-0.1087		0.1004	-0.7867	0.1279	-0.6338
Low Income < $5,000	-0.0424		-0.0283		-0.9355	0.0372	-0.5352
	-0.0787			-0.0265	-1.1655	0.0175	-0.3973
		-0.0577	-0.0314		-0.7639	0.0417	-0.5435
		-0.0831		-0.0378	-0.9402	0.0305	-0.4052
Medium Income $5,000 - 15,000	0.0159		-0.1233		-0.3627	0.1498	-0.6861
	-0.0956			-0.0622	-0.4882	0.1479	-0.7054
		-0.0386	-0.0931		-0.3794	0.1529	-0.6940
		-0.1033		-0.0745	-0.5258	0.1546	-0.6845
High Income > $15,000	-0.3436		0.1388		-1.1709	0.1633	-0.4346
	-0.1476			0.0678	-0.7461	0.1468	-0.9152
		-0.2817	0.1070		-1.2271	0.1428	-0.5386
		-0.1269		0.0719	-0.7798	0.1367	-0.9842

TABLE 4.5

FERTILITY EQUATION, LINEAR MODEL

Dependent Variable: FAMSIZE (family size)

INCOME GROUP	WEEKS	WORKER	INCWAGES $000	FAMINC $000	SCHOOL	CATHOLIC	AGEFTMAR	CONSTANT	R^2	SEE
Total	-0.00272 (0.5)		-0.18889* (3.3)		0.07313* (2.1)	0.52731* (3.5)	-0.05826* (4.3)	3.21021* (6.9)	0.0949	1.5954
	-0.01049* (2.9			0.05555* (4.8)	-0.00831 (0.2)	0.48505* (3.2)	-0.06233* (4.6)	3.62461* (8.1)	0.1189	1.5742
		-0.20211 (1.0)	-0.13757* (2.7)		0.07183* (2.0)	0.53130* (3.5)	-0.05961* (4.4)	3.30046* (7.2)	0.0963	1.5942
		-0.55008* (3.4)		0.05421* (4.7)	-0.00306 (0.1)	0.50449* (3.4)	-0.06171* (4.6)	3.57681* (8.0)	0.1245	1.5691
Low < $5000	0.01459 (1.3)		-0.02828 (1.2)		-0.02089 (0.3)	-0.08011* (3.5)	-0.06662* (2.2)	4.1139	0.0666	1.7253
	0.00614 (0.1)			0.28259* (2.5)	-0.04883 (0.7)	-0.21445 (0.6)	-0.05426** (1.8)	3.1685	0.0959	1.7344
		-0.01111 (0.0)	-0.09969 (0.1)		-0.04273 (0.5)	-0.11388 (0.3)	-0.06529* (2.2)	4.38603	0.0524	1.7384
		-0.11726 (0.3)		0.28071* (2.4)	-0.04057 (0.5)	-0.24661 (0.7)	-0.05502** (1.8)	3.21196	0.0927	1.7374
Medium $5000-15000	0.00294 (0.5)		-0.28749* (4.1)		0.08084** (1.9)	0.74474* (4.2)	-0.05465* (3.7)	3.16310	0.1796	1.4215
	-0.01621* (3.9)			0.05847** (1.6)	0.02859 (0.6)	0.72833* (4.0)	-0.05529* (3.7)	3.16055	0.1407	1.4550
		-0.14692 (0.6)	-0.23805* (4.0)		0.07856** (1.8)	0.75490* (4.3)	0.05543* (3.8)	3.24128	0.1802	1.4210
		-0.72010* (3.9)		0.05348** (1.5)	0.01627 (0.2)	0.76254* (4.2)	-0.05249* (3.5)	3.24240	0.1413	1.4544
High > $15000	-0.01690 (0.9)		0.01451 (0.1)		0.12488 (1.2)	0.77446** (1.6)	-0.11811** (1.8)	4.05673	0.1199	1.9142
	-0.01581** (1.7)			0.05039** (1.9)	-0.05758 (0.6)	1.15707* (2.7)	-0.11179* (2.1)	5.04055	0.3230	1.5732
		-0.75529 (0.9)	0.00807 (0.1)		0.11996 (1.2)	0.72787 (1.5)	-0.12379** (1.9)	4.24472	0.1199	1.9143
		-0.68161 (1.5)		0.05047** (1.9)	-0.06345 (0.7)	1.10908* (2.6)	-0.11763* (2.2)	5.22010	0.3175	1.5795

*Significant at 5% level
**Significant at 10% level

Total Number of Observations 464
Ordinary Least Squares Equation

Parentheses Values are t-Statistics

income variable, INCWAGES, has an inverse relation in all but the high income group. It was significant for the total and middle income groups. The labour force status variable, WEEKS or WORKER, exhibited mixed relationship with family size and is significant only when WEEKS and FAMINC variables appeared together. Both SCHOOL and CATHOLIC variables have no relation with family size and their effect is not significant in many cases. Age at marriage has the expected sign and significant in all cases. Among the income categories, the total and middle income groups are better represented by this specification. From the computed F-statistics in Table 4.3 there is a significant difference between income groups when examining Canadian fertility behaviour. It appears that the fertility equation with family size as dependent variable is inferior to CHILDREN as a dependent variable. In the CHILDREN equation a large number of coeffients are statistically significant and have the acceptable signs than the FAMSIZE equation.

The estimated elasticity of fertility with respect to the exogeneous variables in the family size equation is reported in Table 4.6. The income elasticity of fertility is positive and ranges from 0.13 to 0.37. The income elasticity of fertility measured in terms of income from wages and salaries is negligibly small. The price elasticity measured by the elasticity of fertility with respect to level of schooling is small and negative for low income groups.

TABLE 4.6

ESTIMATED ELASTICITIES, LINEAR MODEL

Dependent Variable: FAMSIZE (family size)

INCOME GROUP	WEEKS	WORKER	INCWAGES	FAMINC	SCHOOL	CATHOLIC	AGEFTMAR
Total Income	-0.0283		-0.0521		0.2007	0.0627	-0.3544
	-0.0408			0.1410	-0.0228	0.5760	-0.3791
		-0.0165	-0.0379		0.1971	0.0631	-0.3626
		-0.0450		0.1376	-0.0084	0.0600	-0.3753
Low Income < $5,000	0.0410		-0.0029		-0.0577	-0.0239	-0.4334
	0.0173			0.2589	-0.1350	-0.0640	-0.3530
		-0.0007	-0.0101		-0.1181	-0.0340	-0.4247
		-0.0070		0.2571	-0.1121	-0.0736	-0.3579
Medium Income	0.0122		-0.0832		0.0213	0.0823	-0.3298
$5,000 - 15,000	-0.0672			0.1446	0.0075	0.0805	-0.3337
		-0.0130	-0.0689		0.0207	0.0834	-0.3345
		-0.0635		0.1323	0.0043	0.0843	-0.3168
High Income > $15,000	-0.1007		0.0001		0.4653	0.1041	-0.8852
	-0.0942			0.3651	-0.2145	0.1555	-0.8378
		-0.0893	0.0000		0.4469	0.0978	-0.9278
		-0.0806		0.3656	-0.2364	0.1491	-0.8816

For them, a 100% increase in education would reduce the demand for children by 11%. The elasticity of fertility with respect to age at marriage is negative and small. It appears that the sign and magnitude of elasticities of fertility measured by family size are consistent with the theory.

4.3.2 Estimated Interaction Model

The interaction model reflects the differential impact of variation in income and wife's education on the opportunity cost of children between families when the wife works and families when the wife does not work. The interaction model with children as the dependent variable is estimated separately with WEEKS and WORKER as independent variables for the three income groups. The results are reported in Table 4.7. Both the WEEKS and the WORKER variables have the expected signs and are significant for total income group. The coefficient of the wife's education has a negative sign and is signficant. The coefficients of family income is negative but not statistically significant. Other independent variables CATHOLIC and AGEFTMAR are statistically significant at the 5% level. In the equation with WEEKS as independent variable, the interaction term is significant at 10% level.

For the low income families, the labour force status of married women is signficant and reduces the number of

TABLE 4.7

FERTILITY EQUATION, INTERACTION MODEL

Dependent Variable: CHILDREN (number of children ever born)

INCOME GROUP	WEEKS	WORKER	FAMINC $000	FAMEDCT FAMINC*SCH OOL,$000	SCHOOL	CATHOLIC	AGEFTMAR	CONSTANT	R^2	SEE
Total	-0.01946* (3.8)		-0.08680 (1.2)	0.01087** (1.7)	-0.31994* (4.1)	0.73863* (3.4)	-0.08088* (4.2)	7.50456* (8.1)	0.1560	2.2653
		-0.97112* (4.2)	-0.06526 (0.9)	0.00866 (1.4)	-0.29172* (3.7)	0.77665* (3.6)	-0.07994* (4.1)	7.18990* (7.8)	0.1618	2.2575
Low < $5000	-0.02925* (2.0)		-1.0576* (1.5)	0.1117** (1.6)	-0.69435* (3.1)	0.20420 (0.4)	-0.05806 (1.2)	11.05461	0.1614	2.7913
		-1.38265* (2.0)	-0.99544** (1.5)	0.1037** (1.5)	-0.59191* (2.6)	0.28802 (0.5)	-0.05910 (1.2)	10.12645	0.1612	2.7917
Medium $5000-15000	-0.01565* (2.5)		-0.01521 (0.1)	-0.00018 (0.0)	-0.12010 (0.5)	0.90811* (3.5)	-0.07952* (3.6)	5.65428	0.1394	2.1163
		-0.79646* (2.9)	-0.02923 (0.4)	0.00086 (0.0)	-0.13923 (0.6)	0.95057* (3.6)	-0.07725* (3.5)	5.83207	0.1460	2.1081
High > $15000	-0.02368* (2.2)		-0.07002 (0.3)	0.01301 (0.7)	-0.46894 (1.2)	1.00589* (2.1)	-0.11821* (2.0)	9.07352	0.3902	1.7316
		-1.03041* (2.0)	-0.06443 (0.3)	0.01253 (0.6)	-0.46625 (1.2)	0.93250* (2.0)	-0.12664* (2.1)	9.21015	0.3823	1.7427

*Significant at 5% level
**Significant at 10% level
Total Number of Observations 464
Ordinary Least Squares Estimation
Parentheses Values are t-Statistics.

children ever born. Family income is significant at 10% level and the interaction term is also significant at the same level. The level of education significantly reduces fertility but religion and age at marriage have no statistically significant effect on fertility.

The medium income family's fertility behaviour is significantly affected by the working status of mothers. However, family income, the interaction term, and education are not significant. The high income families showed more or less the same fertility behaviour as the middle income families. The labour force status of the mother is an important determinant of demand for children. High income parents' desire for additional children is independent of family income, level of schooling or the interaction term. Religion and age at marriage significantly affect the number of children ever born. The statistic R^2 is highest for this group.

In summary, from the above regression analysis, the interaction model with CHILDREN as a dependent variable satisfactorily represents the fertility behaviour of the low income families. There are no significant structural differences among income groups (Table 4.13).

The interaction model with FAMSIZE as a dependent variable is reported in Table 4.8. For the total income category, the labour force status is significant and inversely related to fertility. The family income has a direct impact

TABLE 4.8

FERTILITY EQUATION, INTERACTION MODEL

Dependent Variable: FAMSIZE (family size)

INCOME GROUP	WEEKS	WORKER	FAMINC $000	FAMEDCT=FAMINC*SCHOOL $000	SCHOOL	CATHOLIC	AGEFTMAR	CONSTANT	R^2	SEE
Total	-0.01010* (2.8)		0.13343* (2.7)	-0.00715** (1.6)	0.05758 (1.1)	0.49736* (3.3)	-0.06031* (4.5)	2.88321* (4.5)	0.1239	1.5714
		-0.55717* (3.4)	0.14503* (2.9)	-0.00833** (1.9)	0.07476 (1.4)	0.51914* (3.5)	-0.05951* (4.5)	2.71336* (4.3)	0.1314	1.5647
Low < $5000	0.00730 (0.8)		0.66820** (1.6)	-0.04179 (1.0)	0.06338 (0.5)	-0.25044 (0.7)	-0.05391** (1.7)	2.13956	0.1029	1.7353
		-0.08877 (0.2)	0.61423 (1.4)	-0.03613 (0.9)	0.05482 (0.4)	-0.28145 (0.8)	-0.05472** (1.8)	2.3425	0.0980	1.7400
Medium $5000-15000	-0.01555* (3.7)		0.23665* (1.5)	-0.01739 (0.9)	0.19155 (1.3)	0.71461* (4.0)	-0.05366* (3.5)	1.47204	0.1445	1.4542
		-0.69134* (3.7)	0.23262 (1.4)	-0.01746 (0.9)	0.18043 (1.1)	0.74742* (4.1)	-0.05097* (3.4)	1.54346	0.1453	1.4536
High > $15000	0.01929* (2.0)		-0.20120 (1.2)	0.02161** (1.5)	-0.54674** (1.6)	1.24768* (3.0)	-0.13147* (2.4)	11.21115	0.3499	1.5560
		-0.84502** (1.9)	-0.19723 (1.1)	0.02126** (1.5)	-0.54536** (1.6)	1.18815* (2.8)	-0.13844* (2.5)	11.33792	0.3436	1.5636

*Significant at 5% level
**Significant at 10% level
Total Number of Observations 464
Ordinary Least Squares Estimation
Parentheses Values are t-Statistics

on the number of children ever born. The interaction term is indirectly associated with family size and is statistically significant. Religion and age at marriage are significant.

The regression results for the low income families are not exciting. Age at marriage is significant at 10% level. Family income is significant in the equation when WEEKS appeared as an independent variable.

Judging from the significance for the medium income group, some coefficients showed improvement over low income group. Labour force variables are significant in both the equations. The family income variable has a positive coefficient but is significant at 10% level in one case and not significant in the other. Religion and age at marriage are significant determinants of fertility behaviour. The schooling variable has a sign opposite of what is expected and is not significant. The interaction variable is not significant.

The interaction model represents well the high income group. The labour force variables are significant even though WEEKS variable has a positive sign. Family income is not significant but has negative influence on fertility. The interaction term is significant at 10% level. All other variables are significant and have expected signs. There is an improvement in R^2 value (0.35).

In the interaction model with FAMSIZE as a dependent variable most of the parameters have the predicted signs and are

statistically significant. This is an improvement over the other equation with CHILDREN as dependent variable. The relationships expressed by income groups are significantly different (Table 4.13). From the F-test,it appears that there are significant differences in parameters among different income groups, the income coefficient is three times larger than the other income groups. Similar differences can be found for the labour force variables. It is interesting to note that for the high income group only the sign of family income and education are negative.

The estimated elasticities of fertility with respect to the exogeneous variables in the interaction model with CHILDREN and FAMSIZE as the dependent variables are reported in Tables 4.9 and 4.10, respectively. The elasticity of fertility with respect to the wife's education is negative. The income elasticity of fertility for the aggregate income group is positive when CHILDREN is the dependent variable but negative when family size is the dependent variable. The elasticity of fertility with respect to low and middle income families (Table 4.9) is negative. The education elasticity of fertility is always higher for the WORKER equation than for WEEKS equation. The income elasticities are smaller in the CHILDREN equation than the family size equation, whereas education elasticities are higher for the former than in the latter. It appears that results obtained from the CHILDREN equation are consistent with the theoretical specification of interaction model.

TABLE 4.9

ESTIMATED ELASTICITIES, INTERACTION MODEL

Dependent Variable: CHILDREN (number of children ever born)

INCOME GROUP	WEEKS	WORKER	FAMINC	SCHOOL	CATHOLIC	AGEFTMAR
Total Income	-0.1028		0.0832	0.3816	0.1193	-0.6687
		-0.1079	0.0797	0.3039	0.1254	-0.6609
Low Income < $5,000	-0.0879		-0.0237	1.0108	0.0333	-0.4038
		-0.0883	-0.0346	0.9386	0.0467	-0.4110
Medium Income	-0.0956		-0.0622	-0.0072	0.1478	-0.7052
$5,000 - 15,000		-0.1035	-0.0742	0.0318	0.1547	-0.6851
High Income > $15,000	-0.1620		0.6675	1.2479	0.1552	-1.0172
		-0.1399	0.6679	1.1899	0.1439	-1.0897

TABLE 4.10

ESTIMATED ELASTICITIES, INTERACTION MODEL

Dependent Variable: FAMSIZE (family size)

INCOME GROUP	WEEKS	WORKER	FAMINC	SCHOOL	CATHOLIC	AGEFTMAR
Total Income	-0.0392		-0.1536	-0.1851	0.0591	-0.3668
		-0.0455	-0.1524	-0.2156	0.0617	-0.3620
Low Income < $5,000	0.0205		0.2577	-0.3542	-0.0380	-0.3507
		-0.0053	0.2563	-0.3036	-0.0427	-0.3560
Medium Income	-0.0645		0.1416	-0.4433	0.0790	-0.3230
$5,000 - 15,000		-0.0610	0.1298	-0.4451	0.0826	-0.3068
High Income > $15,000	0.1149		0.3506	1.8062	0.1676	-0.0424
		-0.1000	0.3501	1.7769	0.1597	-0.0447

The empirical equations of the interaction model for the effects of economic growth on fertility trends and differentials depend on the direction and magnitude of the effects of family income and wife's education on the fertility of various population groups. This can be examined by plotting partial derivatives of fertility with respect to family income and the wife's education. The partial derivatives[1] are shown in Figures 4.1 and 4.2. These partial derivatives are computed from the estimated regression coefficients in Table 4.7 and 4.8. In Figure 4.1, we see that, for the children's equation, growth in education will always tend to depress fertility because $\frac{\partial C}{\partial k}$ is negative for all income groups. In contrast the growth in family income may either raise or lower fertility depending on the level of wife's education. In Figure 4.2, we see that for the children's equation $\frac{\partial C}{\partial H}$ is negative for values of education less than about grade 8 and positive for levels of the wife's

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[1]The estimated interaction model is of the form,

$$\begin{aligned} \text{CHILDREN/FAMSIZE} = b_0 &+ b_1(\text{WORKER/WEEKS}) + b_2\text{FAMINC} \\ &+ b_3(\text{FAMINC*SCHOOL}) + b_4\text{SCHOOL} + b_5\text{CATHOLIC} \\ &+ b_6\text{AGEFTMAR}. \end{aligned}$$

The partial derivative of fertility with respect to family income $(\partial C/\partial H) = \dfrac{\partial(\text{CHILDREN/FAMSIZE})}{\partial(\text{FAMINC})} = b_2 + b_3(\text{SCHOOL})$

The partial derivative of fertility with respect to wife's education $(\partial C/\partial k) = \dfrac{\partial(\text{CHILDREN/FAMSIZE})}{\partial(\text{SCHOOL})} = b_4 + b_3(\text{FAMINC})$

The partial derivatives, $\partial C/\partial H$ and $\partial C/\partial k$, reported in the figure (4.1) and (4.2) are computed at the sample means.

FIGURE 4.1: PARTIAL DERIVATIVES OF FERTILITY WITH RESPECT TO FAMILY INCOME $(\frac{\partial C}{\partial H})$

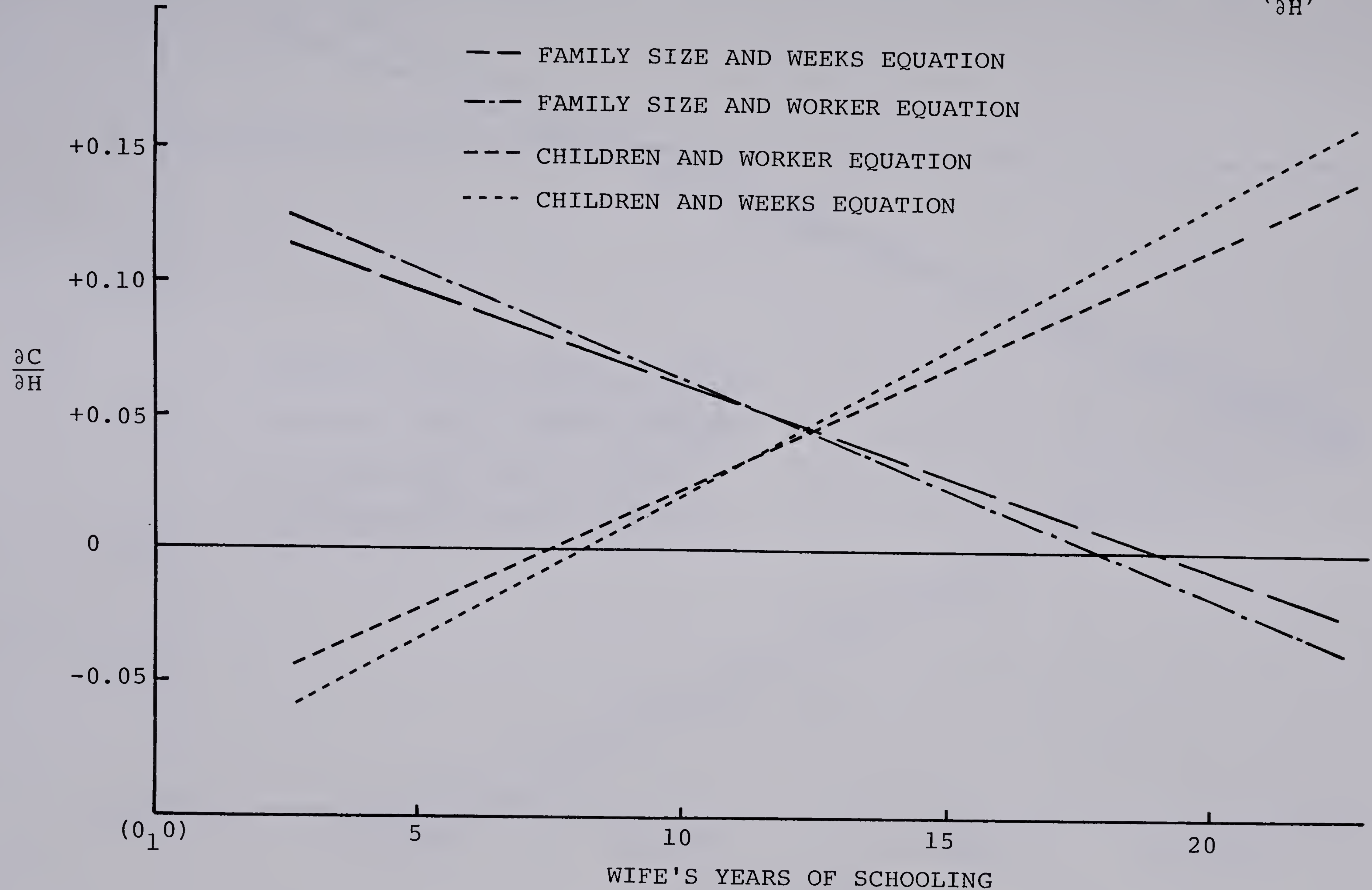
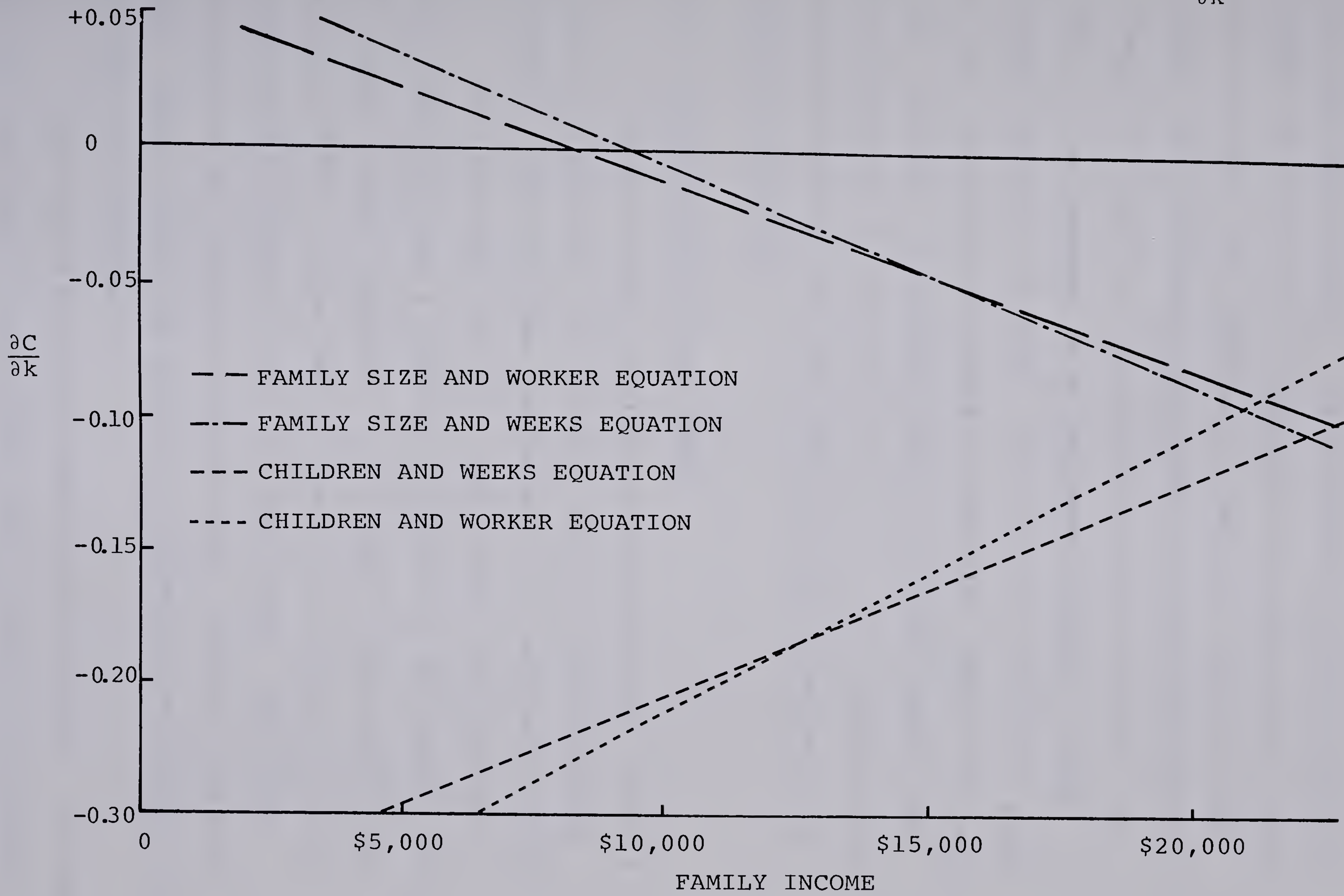


FIGURE 4.2: PARTIAL DERIVATIVES OF FERTILITY WITH RESPECT TO EDUCATION ($\frac{\partial C}{\partial k}$)



schooling above grade 9. As the level of wife's education exceeds about 8 years of schooling, the sign of the income effect changes from negative to positive. Thus, as the average level of education increases, an increasing proportion of married couples in the population tends to raise its fertility in response to an increase in family income, holding education constant. If the wife's education level is low, the effect of income on fertility tends to be negative. However, it becomes positive as these levels rise The results of the interaction equation with FAMSIZE as the dependent variable are not consistent with the theory of household behaviour.

4.3.3 Estimated Non-Linear Model

The non-linear fertility relationship was tested by a semi log function. Here family size was the dependent variable. The estimated coefficients are reported in Table 4.11. For the total category, the labour force status is significant and has a negative influence on the family size. The family income expressed in the log form has significant positive effect on the family size. This confirms the non-linear relationship of fertility and income. Religious affiliation and early marriage strongly determine the family size. About 13% of the variation in family size is explained by this specification.

The results for lower income groups are poor. The age at first marriage is significant but the other coefficients,

TABLE 4.11

FERTILITY EQUATION, NON-LINEAR MODEL (LOG SPECIFICATION)

Dependent Variable: Log(FAMSIZE)

INCOME GROUP	WEEKS	WORKER	LFAMINC	SCHOOL	CATHOLIC	AGEFTMAR	CONSTANT	R^2	SEE
Total	-0.00448* (3.4)		0.17397* (4.1)	-0.00103 (0.1)	0.18144* (3.3)	-0.02759* (5.7)	-0.09854	0.13280	0.5634
		-0.19674* (3.3)	0.17274* (4.1)	-0.00133 (0.1)	0.18655* (3.4)	-0.02729* (5.6)	-0.09898	0.13140	0.5688
Low < $5000	0.00242 (0.7)		0.04507 (0.3)	-0.01412 (0.5)	0.04828 (0.4)	-0.03234* (2.7)	1.83694	0.07686	0.6658
		0.02980 (0.2)	-0.05542 (0.4)	-0.01480 (0.5)	0.03892 (0.3)	-0.03241* (2.7)	1.95051	0.07299	0.6672
Medium $5000-15000	-0.00679* (4.4)		0.20409** (1.7)	0.00689 (0.4)	0.22674* (3.5)	-0.02483* (4.5)	-0.47963	0.16070	0.5267
		-0.26947* (4.0)	0.18001** (1.5)	0.00097 (0.1)	0.23841* (3.6)	-0.02355* (4.3)	-0.24966	0.14950	0.5302
High > $15000	-0.00598** (1.9)		0.22228 (0.9)	0.00128 (0.0)	0.34208* (2.4)	-0.04613* (2.6)	-0.22803	0.27850	0.5336
		-0.21960 (1.4)	0.24369 (1.0)	-0.00227 (0.1)	0.32256* (2.2)	-0.04784* (2.6)	-0.38251	0.26070	0.5402

*Significant at 5% level
**Significant at 10% level
Total Number of Observations 454
Ordinary Least Squares Method of Estimation
Parentheses Values are t-Statistics

except SCHOOL, are not significant. For the medium income group all the coefficients have the expected signs and are significant. The R^2 (0.16) is relatively large. For the higher income group family size is strongly determined by religion and age at marriage. Catholic women have larger families and women who marry late have smaller family size. However, the family income, schooling, and work status are not significant explanatory variables. The R^2 (0.38) is very high for this income group. Overall the log specification of the fertility equation is satisfactory even though there are some disparities among the income groups. From the F-test reported in Table 4.13 this specification is not significantly different among the income groups.

The estimated elasticities of fertility with respect to the exogeneous variables in the log linear model are reported in Table 4.12. The income elasticity of fertility is the coefficient of Log(FAMINC) in the estimated equation. It is always positive except for the low income group. The income elasticity increases with income. The price elasticity, measured as the elasticity of fertility with respect to wife's education, is positive for the middle income group. Religion has small positive elasticity while the age at marriage and labour force status have negative elasticity for demand for children.

4.3.4 Estimated Simultaneous Equation Model

In the simultaneous equation model both fertility

TABLE 4.12

ESTIMATED ELASTICITIES, LOG LINEAR MODEL

Dependent Variable: Log(FAMSIZE)

INCOMES GROUP	WEEKS	WORKER	FAMINC	SCHOOL	CATHOLIC	AGEFTMAR
Total Income	-0.0647		0.1740	-0.0105	0.0802	-0.6239
		-0.0598	0.1727	-0.0136	0.0824	-0.6171
Low Income < $5,000	0.0228		0.0451	-0.1307	0.0245	-0.7047
		0.0061	-0.0554	-0.1370	0.0198	-0.7063
Medium Income	-0.1068		0.2041	0.0711	0.0950	-0.5668
$5,00 - 15,000		-0.0901	0.1800	0.0100	0.0999	-0.5376
High Income > $15,000	-0.1104		0.2223	0.0148	0.1425	-1.0718
		-0.0805	0.2437	-0.0262	0.1344	-1.1115

TABLE 4.13

SUMMARY OF STEP WISE CHOW TEST (STABILITY OF COEFFICIENTS) RESULTS

ESTIMATED EQUATION	Reference Table	F-Statistics	Critical Values
LINEAR MODEL			
CHILDREN = f(WEEKS, INCWAGES, Other Variables)	(4.3)	1.07	
f(WEEKS, FAMINC, Other Variables)		0.96	$F_{12,446}$ at 5%
f(WORKER, INCWAGES, Other Variables)		0.80	
f(WORKER, FAMINC, Other Variables)		0.77	= 1.75
FAMSIZE = f(WEEKS, INCWAGES, Other Variables)	(4.5)	2.26	
f(WEEKS, FAMINC, Other Variables)		2.44	$F_{12,446}$ at 5%
f(WORKER, INCWAGES, Other Variables)		2.03	
f(WORKER, FAMINC, Other Variables)		2.12	= 1.75
INTERACTION MODEL			
CHILDREN = f(WEEKS, FAMINC, Other Variables)	(4.7)	0.92	$F_{14,443}$ at 5%
f(WORKER, FAMINC, Other Variables)		0.78	= 1.67
FAMSIZE = f(WEEKS, FAMINC, Other Variables)	(4.8)	2.22	$F_{14,443}$ at 5%
f(WORKER, FAMINC, Other Variables)		1.85	= 1.67
LOG SPECIFICATION			
LOG(FAMSIZE) = f(WEEKS,LFAMINC,Other Variables)	(4.11)	1.60	$F_{12,436}$ at 5%
f(WORKER,LFAMINC,Other Variables)		1.23	= 1.75

and labour force are endogeneous to the system.[1] Employing the two stage least squares method the fertility and the labour force equations (with WEEKS as dependent variable) are estimated.[2] The simultaneous interaction of fertility with other variables is reported in Table 4.14. In the fertility equation with CHILDREN as dependent variable and WEEKS and INCWAGES as explanatory variables, the wage rate variable has a positive coefficient but is not statistically significant. All other variables are significant and possess acceptable signs. When the same equation was estimated with family income instead of income from wages and salaries, all independent variables exhibit strong influence on fertility.

In the second set of regressions, family size instead of number of children as dependent variable is estimated. There are not many deviations from the previous specification except INCWAGES is significant in all cases. The level of schooling is not significant.

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[1]If one or more or the explanatory variables is correlated with u, then the ordinary least square method of estimation yields inconsistent estimators. Here one of the explanatory variables, labour force status, is correlated to the random disturbance term u, so we used two stage least squares method which gives consistent estimators. The instrumental variables are; FAMINC, SCHOOL, CATHOLIC, AGEFTMAR, INCWAGES, IMIGRANT, AND TECHNIC.

[2]The labour force equation with WORKER as dependent variable cannot be estimated here due to estimation problems. Recently some studies emerged using Maximum Likelihood methods for estimating a dichotomous endogeneous variable in a system of equations. This could not be incorporated here due to lack of computing program.

The estimated regression coefficients of the labour force equation with WEEKS as dependent variable are reported in Table 4.15. In the labour supply equation, CHILDREN or FAMSIZE are not significant. Significance of income from wages and salaries indicates that more married women participate in the labour force at higher wages.Similarly,technical skills encourage more females to enter the labour market. Family income is another significant factor for female labour force participation. For the low income families it is economic necessity to participate in the labour force.

It is interesting to estimate the elasticity of fertility with respect to the explanatory variables in a simultaneous equation model of fertility. Table 4.16 provided elasticity multipliers. The elasticities are calculated from the reduced form equations and at the mean values of the explanatory variables. The income elasticity of fertility measured by family income or wife's income from wages and salaries is very low. The price elasticity measured by the years of schooling is negative for the CHILDREN's equation and is higher than the income elasticity in magnitude as expected. The elasticity of fertility with respect to religion and age at marriage have the acceptable size and signs. In general, the elasticity multipliers are smaller in magnitude when compared with single equation models.

4.4 Summary

In summary, the four economic models contribute to

TABLE 4.14

FERTILITY EQUATION, SIMULTANEOUS EQUATION MODEL

Dependent Variables: CHILDREN (number of children ever born)
FAMSIZE (family size)

DEPENDENT VARIABLE	WEEKS	SCHOOL	CATHOLIC	AGEFTMAR	INCWAGES	FAMINC	CONSTANT	R^2	SEE
CHILDREN (1)	-0.09610**	-0.21144*	0.74356*	-0.09571*	0.56078		7.54130*	0.0700	2.5803
	(1.5)	(3.3)	(3.0)	(3.6)	(1.1)		(5.7)		
(2)	-0.02775*	-0.20489*	0.75832*	-0.08018*		0.03307*	6.39198*	0.1468	2.2772
	(3.9)	(4.0)	(3.5)	(4.1)		(2.0)	(9.9)		
FAMSIZE (1)	-0.12732*	0.01270	0.46869*	-0.08923*	0.84471**		5.37217*	0.0038	2.4476
	(2.0)	(0.2)	(2.0)	(3.5)	(1.7)		(4.3)		
(2)	-0.02462	0.01553	0.48663*	-0.06609*		0.05804*	3.64639*	0.1030	1.6005
	(4.9)	(0.4)	(3.2)	(4.8)		(5.0)	(8.0)		

*Significant at 5% level
**Significant at 10% level

Total number of observations 464
Numbers in parentheses are t-statistics

TABLE 4.15

LABOUR FORCE EQUATION, SIMULTANEOUS EQUATION MODEL

Dependent Variable: WEEKS (number of weeks worked)

CHILDREN	FAMSIZE	INCWAGES	SCHOOL	IMIGRANT	TECHNIC	FAMINC	CONSTANT	R^2	SEE
1.50565 (1.2)		8.30998* (17.7)	-0.09063 (0.2)	0.98515 (0.6)	4.92927* (2.2)	-0.25335* (2.1)	4.38487 (0.6)	0.5045	14.7963
0.36656 (0.3)		7.95802* (18.7)	-0.53250 (1.3)	0.50717 (0.3)	4.60581* (2.1)		10.1102** (1.5)	0.5322	14.3330
	2.45749 (1.4)	8.46995* (16.5)	-0.4296 (1.3)	1.76387 (0.9)	4.49943* (2.0)	-0.34872* (2.2)	5.83017 (1.0)	0.5220	14.5242
	-0.46767 (0.4)	7.80824* (18.8)	-0.60512** (1.9)	0.12971 (0.1)	4.71696* (2.2)		13.3423* (2.9)	0.5336	14.3121

*Significant at 5% level
**Significant at 10% level

Total number of observations 464
Number in parentheses are t-statistics

TABLE 4.16

ESTIMATED ELASTICITY MULTIPLIERS, SIMULTANEOUS EQUATION MODEL

DEPENDENT VARIABLE	SCHOOL	CATHOLIC	AGEFTMAR	INCWAGES	FAMINC	IMIGRANT	TECHNIC
CHILDREN (1)							
CHILDREN	-0.66068	0.10493	-0.69129	-0.00779	0.00734	-0.00613	-0.01663
WEEKS	-0.25234	0.02991	-0.19705	0.05674	-0.01446	0.01207	0.03276
CHILDREN (2)							
CHILDREN	-0.70208	0.12127	-0.65623	-0.00819	0.01130	-0.00103	-0.00508
WEEKS	-0.42480	0.00842	-0.04553	0.05590	0.00078	0.00704	0.03469
FAMSIZE (1)							
FAMSIZE	0.13884	0.04242	-0.41335	-0.15491	0.00859	-0.00932	-0.01290
WEEKS	-0.21020	0.02683	-0.26143	0.05700	-0.01736	0.01884	0.10131
FAMSIZE (2)							
FAMSIZE	0.08447	0.05850	-0.40666	-0.00536	0.01491	-0.00018	-0.00347
WEEKS	-0.43754	-0.00710	0.04895	0.05605	-0.00179	0.00184	0.03630

SOURCE: Tables 4.14 and 4.15

our understanding of Canadian fertility behaviour. The selection of acceptable specifications is based on R^2, the t-statistics, and proper signs of the regression coefficients. Based on these criteria, the simultaneous equation model performed better than the other specifications. Most of the coefficients have acceptable signs and are significant. The linear model is satisfactory to the extent that a large number of parameters have expected signs and are significant. Based on the above criteria, CHILDREN equation is a better specification than the FAMSIZE equation for examining the Canadian fertility behaviour.

According to the F-test, between the income groups, there is no significant difference in fertility with CHILDREN as the dependent variable, but there are significant differences when FAMSIZE is the dependent variable. Even though there are no shifts in fertility variation, one can say that the parameters differ for the income groups. Moreover, some of the differences in regression results between CHILDREN and FAMSIZE equations can be attributed to the measurement of the variables. The correlation between the two variables is 0.51. The correlation between family income and family size is 0.19 whereas the correlation between CHILDREN and FAMINC is -0.01. Also the income groups are based on family income level. From these observations one can speculate that there is income differential when FAMSIZE is the dependent variable. Another conjecture would be that fertility-income

relationship is non-linear because for the interaction model, which is non-linear, the observed R^2 is relatively high and more coefficients are statistically significant. The impact of socio-economic factors on fertility differ according to the income status. For example, high income families are distinguishable with high R^2 values, larger, and significant coefficients than the low and medium income families. In many cases there is evidence that this relationship was negative for low and middle income groups but positive for the high income group.

The income elasticity and price elasticity of fertility have the predicted signs. From the interaction model one can infer that as the average level of education rises, more married women react with positive income elasticity

In general, mother's schooling, religious background, and the age at first marriage are important factors in fertility regulation. At an aggregate level,it appears that children are not "inferior goods" as is evident from a positive income-fertility relationship in many cases. Based on the significance of coefficients we can say that low and high income families are more sensitive to the socio-economic factors than the middle income families. For example, social factors like religious association,or economic factors like income are significant determinants of fertility decisions for low and high income households.

CHAPTER V

COMPARISON WITH EMPIRICAL STUDIES ON FERTILITY

5.1 Introduction

In recent years empirical analysis of the economic determinants of fertility behaviour using the household production functions and the theory of allocation of time have been attempted by both demographers and economists. Some of these researchers are Sanderson and Willis (1971), Willis (1973), Cain and Weininger (1973), Gardner (1973) Michael (1973), Schultz (1973), and Ben Porath (1973). The application of economic framework of fertility behaviour within a simultaneous equation model was attempted by Madduri and Gupta (1974), and by Hout (1978). The estimated coefficients of the economic models presented in this dissertation are compared to those in the above stated studies. However, one should remember that a complete comparison is not possible because each study uses different specification, data, method of estimation, and time period. They also refer to different countries. The direction of relationship and the significance of the independent factors may be compared for analytical purposes.

5.2 Comparison

In order to make the comparison easier, a summary table of the empirical results is provided in Table 5.1.

TABLE 5.1

COMPARISON OF FERTILITY STUDIES OF ECONOMIC DETERMINANTS OF FERTILITY

AUTHOR	GARDNER	SANDERSON AND WILLIS	CAIN AND WEININGER	MICHAEL	WILLIS
COUNTRY/DATA	U.S./Cross section (North Carolina Rural Families)	U.S./Cross section (Group Means, 1940,1960 Census)	U.S./Cross section (SMSA 1960, Cities 1940 Census)	U.S./Cross section (National Fertility Study)	U.S./Cross section (Grouped, 1960 Census)
FUNCTIONAL FORM/ ESTIMATED METHOD	Linear/OLS	Linear and Non-Linear (Interaction)/OLS	Linear/OLS	Linear/OLS	Non-Linear (Interaction)/OLS
DEPENDENT VARIABLE	Completed Family Size	Fertility Rate	Fertility Rate	Monthly Birth Probability	Fertility Rate
INDEPENDENT VARIABLES					
Wife's Education	- *	- *	- *	- *	- *
Husband's Education	- *	...	...	+ or -*	...
Family Income	+ *	...	+	...	...
Wife's Wages	...	...	- *	...	...
Husband's Wages	...	- *	+ *	...	- *
Interaction Term	...	+ *	...	...	+ *
Religion	...	...	+ or -	controlled	...
Age at Marriage	...	...	...	...	...
Wife's Lab. Force	...	...	...	...	...
Race	+*	...	...	...	...
Region	...	...	- *	...	...
Expected Births	...	...	...	+	...
Child Deaths	...	...	...	...	...
Wife's Age	+	...	...	...	...
					...
					...

TABLE 5.1 (Continued)

AUTHOR	BEN-PORATH	SCHULTZ	MADDURI AND GUPTA	HOUT
COUNTRY/DATA	U.S./Cross section (Household Family Expenditure Survey)	Taiwan/Time series of Cross section	Canada/Time series	U.S./Cross section (1970 U.S. Public Use Sample)
FUNCTIONAL FORM/ ESTIMATION METHOD	Linear, Non-Linear (Interaction)/OLS	Linear/OLS and TSLS	Simultaneous Equation/TSLS	Simultaneous Equation/TSLS
DEPENDENT VARIABLE	Age Adjusted Births	Total Fertility Rate	Crude Brith Rate	No. of Children under 2 years of Age
INDEPENDENT VARIABLES				
Wife's Education	- *	+ *	...	...
Husband's Education	- *	- *	...	...
Family Income	...	...	...	...
Wife's Wages	...	...	...	-
Husband's Wages	...	...	+ *	+ *
Interaction Term	...	...	...	...
Religion	- *	...	...	...
Age at Marriage	...	...	...	- *
Wife's Lab.Force	...	...	- *	-
Race	...	...	...	...
Region	...	...	...	...
Expected Briths	...	...	...	...
Child Deaths	...	+ *	+	...
Wife's Age	...	...	...	...

(-) or (+) indicate the sign on the coefficient and (*) indicates significance at 5% or 10% levels

Here the author, country and the data selected for, the functional specification and the method of estimation, and the dependent variable along with independent variables used in the study are shown. The direction of causality and the significance are noted for each variable. One should exercise certain caution while reading this table. For example, the independent variables are sometimes proxy variables to represent different concepts in fertility analysis. The wife's education can be used either to measure her productivity, fertility control, or price effects, etc. It is presumed that this table provides some overview of different empirical studies on fertility.

In this dissertation there are four different economic models of fertility behaviour. The linear model is comparable to Gardner (1973), Cain and Weiginger (1973), Michael (1973), Ben Porath (1973), and Schultz (1973). The interaction model is compable to Sanderson and Willis (1971), Willis (1973), and Ben Porath (1973). The non-linear model or the log specification has no comparable study. The simultaneous equation model can be compared with Madduri and Gupta (1974), and Hout (1978).

In a linear model with fertility as a dependent variable, Sanderson and Willis (1971) introduced mother's education to capture opportunity cost of children. Our results are in support of their hypothesis that fertility declines as the opportunity cost of children rises. Cain

and Weininger (1973) did a cross sectional analysis of SMSA's for 1960 and cities for 1940 from the U.S. census. They reported a significant negative association between fertility and female wage rate. Our results are similar to theirs except for the high income bracket. Our estimated income elasticity of fertility in the linear model is smaller than Cain and Weininger estimates. They reported an average income elasticity (measured by husband's earnings) between 0.18 and 0.30 for white married women in 1960. Since our results are based on 1971 there may be a shift in these parameters over time.

Gardner (1973) used family size as a dependent variable for measuring fertility. The sign and the magnitude of coefficients of family income, wife's education, and wage rate are comparable to his results. For the medium income families the education coefficient was positive. Schultz (1973) also observed a positive wife's education coefficient for married women in Taiwan. In this specification the income elasticity is close to the one reported by Cain and Weininger.

The interaction model is closely comparable to Willis' (1973) study. Willis used data consisting of a sample of 9,169 white women aged 35 to 64 years, married once, living with their husband, and living in urban areas at the time of the 1960 census. He used two alternative measures of husband's income namely, (i) husband's income at age 40, H(40), and (ii) husband's reported income in 1959, H(NOW), for estimating the fertility demand equation. The wife's years of schooling is used to measure the efficiency parameter measuring her stock of human capital.

Standard Metropolitan Statistical Areas (SMSAs) have been considered to maintain the same urban influences. His dependent variable is the total number of children ever born.[1] His estimated elasticity of fertility with respect to the husband's income (at age 40) and wife's education are -0.0674 and -0.412, respectively. He observed a positive income elasticity for high income and education levels. When the wife's education level is low, the effect of income on fertility tends to be negative, and it becomes positive as the level grows. The elasticity of fertility with respect to wife's education, reported in Table 4.10, is negative but higher in magnitude than the results obtained by Willis. This is not true when CHILDREN is the dependent variable (Table 4.9).

Another comparable study with respect to interaction model is by Ben Porath (1973), who estimated an interaction model for the Israeli married women. In his model the coefficient of wife's education is negative and significant. The elasticity of fertility with respect to the wife's

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[1] For comparison, Willis (1973) estimated equations are reported here.

$$\text{Fertility } H(NOW) = \underset{(7.09)}{0.05983}(COHORT) + \underset{(4.13)}{0.00132}(COHORT)^2 - \underset{(4.09)}{0.06898}(H)$$
$$- \underset{(14.31)}{0.14206}(k) + \underset{(4.71)}{0.00617}(Hk) - \underset{(7.15)}{0.08111}(SMSA)$$
$$+ 4.38947(\text{Constant})$$

$$\text{Fertility } H(40) = \underset{(7.23)}{0.06004}(COHORT) + \underset{(3.88)}{0.00124}(COHORT)^2 - \underset{(7.35)}{0.24836}(H)$$
$$- \underset{(13.97)}{0.17572}(k) + \underset{(7.33)}{0.02023}(Hk) - \underset{(6.17)}{0.07243}(SMSA)$$
$$+ 4.83269(\text{constant})$$

education is -0.335 and that with respect to husband's earnings is -0.22. These estimates are close to our estimates with FAMSIZE as the dependent variable.

With regards to the simultaneous equation model, the Schultz (1973) model is not directly comparable here. His study is a time series of cross sections and he estimated a single reduced form equation with two stage least squares. His proxy variables are not comparable to our explanatory variables. Madduri and Gupta (1974) estimated a simultaneous equation model with four endogenous variables namely, crude birth rate, per capita permanent income, female labour force participation rate, and infant mortality rate. This time series study faced estimation problems like multicollinearity and autocorrelation. Besides, the dependent variable was crude birth rate which is not a good measure of fertility. However, their elasticity multipliers have the same directions as noted here even though they are high in magnitude. The elasticity multiplier of fertility with respect to wife's income from wages and salaries was negative and the income elasticity measured by husband's income was positive.

Hout (1978) estimated a two equation model of fertility behaviour and labour force participation as endogenous variables. His approach is similar to the one attempted in this dissertation. Hout applied two stage least squares method to estimate the regression coefficients. His

estimates are not directly comparable here because his dynamic model was intended to capture fertility differentials at different parity levels. However, cursory explanation shows that, in his fertility equation, the coefficient of employment (equivalent to labour force participation), potential earnings of wife (equivalent to her education), duration of marriage (equivalent to age at marriage) have negative signs. Our results are consistent with his findings. In his study, the coefficient of husband's earnings (equivalent to family income) is positive for low parity and negative for high parity children. In our results the income effect measured either by income from wages and salaries or by family income is positive. In the labour force participation equation, Hout found positive association with wife's potential earnings and negative association with fertility and husband's earnings. But his labour force participation equation has dichotomous dependent variable and the application of two stage least squares yields untenable results. Hout has not provided the elasticity multipliers to compare with.

In conclusion, the economic model of fertility presented in this dissertation corroborates other studies. The direction of causality and the significance of the impact of various socio-economic variables on fertility behaviour concurs with similar investigations. There are wide variations in the magnitude of the coefficients and elasticity multipliers.

CHAPTER VI

CONCLUSIONS

6.1 Summary

The objective of this thesis was to explore the economic determinants of fertility behaviour in the Canadian context. Recent developments in micro-economic theory of consumer behaviour were a valuable tool in achieving this objective. By applying the recent economic approaches to fertility behaviour, four behavioural relationships were specified. The traditional income fertility relationship was tested with a linear model. The non-linear fertility relationship was tested by an interaction and a log linear model. The interrelationship between fertility and female labour force behaviour was also investigated by means of a simultaneous equation model. A one percent sample of individual records from the PUST (Public use Sample Tape) data of the 1971 Census was used to analyse the Canadian Fertility behaviour. The linear and the non-linear models were estimated by ordinary least squares method and the simultaneous equation model by the two stage least squares method.

It has been demonstrated that a complex network of socio-economic variables affect fertility decisions. By cross tabulating the relevant characteristics the following

observations were made. The fertility and income tend to move in a non-linear way, that can be approximated by a U-shaped curve. Mothers with higher education limit their family size. This implies that investments in human capital in the form of education tend to increase employment opportunities, improve knowledge and efficient use of contraceptives, raise potential earnings, delay marriage, select educated husbands, and improve child caring and other consumption activities. Also, increase in female labour force participation reduces fertility. One can speculate that the recent decline in birth rates provides an indication of increasing female labour force participation rates. This can also be interpreted as, investment in human capital increase the potential income form wages and salaries, attract more females into the labour force, and lower the birth rate. Canadian women have strong religious affiliations. For example, Catholic married women tend to have more children. Early married women seem to have more children. In Canada, it appears that most women complete their childbearing process by 44 years of age. There are also rural urban differentials in fertility rates. Across the country there are fertility differentials by province and by age group. Newfoundland has the highest number of children per 1,000 married women in that province, while mothers in British Columbia have the lowest fertility rate. In 1971, a major proportion of married women were in the 25-29 age

group, but their fertility rate was 38% lower than the national rate of 2,666 children per 1,000 married women. Finally, immigrat women have lower fertility rates than Canadian born mothers.

From the estimated regression coefficients, it was found that fertility behaviour in the lower and high income groups is more sensitive to the economic and social status variables than in the medium income families. For example, religious background, labour force participation, and education are not significant factors in shaping fertility in the middle income families. It appears that women from low income families do market work out of economic necessity. The age at marriage is a significant factor in lowering the birth rates.

The estimated price and income effects corroborate other studies. The income elasticity was smaller than those reported by similar researchers. It was noticed that income elasticity of fertility decreases with education and price elasticity of fertility, with respect to family income , also decreases with education.

There appears to be significant differences in fertility among income groups when family size is the dependent variable. There are no such significant differences when the number of children ever born is the dependent variable. Furthermore, based on high

correlation between family size and family income variables one can speculate that there are fertility differentials when family size is the dependent variable.

6.2 Limitations

Some limitations of this study should be noted. Infant mortality rate variable was not used in the fertility relationship. Many researchers like Schultz (1969, 1973, 1975), Ben Porath (1973), and Williams (1977) suggest that child mortality affects birth rates.

Another limitation of this dissertation was that the data used do not represent all the provinces of Canada. Prince Edward Island, the Yukon, and the Northwest Territories were omitted from the PUST data base. In order to assess a complete fertility behaviour in Canada, new data sources have to be found.

Finally, this investigation is based on the new economic approach to fertility behaviour suggested by Becker (1960) and developed by Willis (1973). This scheme of thought is called the "Chicago School" (Sanderson, 1976 and Fulop, 1977). There are two other schools of thought called "Leibenstein's Model" and "Easterlin's Model," which are not emphasized in this study. Leibenstein did not offer a strong alternative economic theory to evaluate his approach to be tested empirically. Similarly, Easterlin emphasizes the secular behaviour of fertility. He suggests that tastes change systematically according to ones upbringing, a concept

of socialization into economic theory. His ideas, as they are, cannot be substantiated and tested. The approaches of Leibenstein and Easterlin are partial since they fail to take into consideration the interactions and feedbacks between the economic and demographic variables. This dissertation has tried to bridge this gap. It is fair to conjecture that the Chicago theory is complementary rather than contradictory to other schools of thought.

6.3 Scope for Future Studies

In this study fertility is defined as the number of children ever born per 1,000 married women. However, desired fertility would be a better measure than actual fertility. In that case one has to introduce fertility control variables and probability of concpetion. One can also introduce quality of children rather than quantity of children (Becker, 1960). It would be interesting to analyse the demand for children in terms of cost per child as in consumer theory. Becker and Tomes (1976) showed that the desired expenditure per child and parental income resulted in a positive relation and caused children to be more expensive for wealthier parents than poor parents.

The fertility model presented here is a static model. The dynamic aspects of fertility behaviour were stressed by Namboodiri (1972), Wilkinson (1973), and Schultz (1973). Such a formulation could not be included here. In cross section data,time has no relevance. A cross sectional time

series may be useful for testing the dynamic nature of fertility behaviour. A time series data is ideal for such an investigation. Madduri and Gupta (1974) made a preliminary attempt in that direction.

From this analysis it appears that there are fertility differentials across Canadian provinces and age groups. It is suggested that the model be disaggregated (i) by level of education, (ii) by province, (iii) by age groups, and (iv) by income groups. Such an analysis would give a detailed perspective of Canadian fertility differentials. It is recommended that Canadian fertility behaviour be explained with fertility, female labour force participation rate, female wages, and female education as endogenous variables. Advanced econometric techniques will be useful to estimate such models.

The data used in this study refers to the 1971 situation. It would be appropriate to conduct similar research with new data such as the 1981 Canada Census.

6.4 Implications

This thesis was aimed at identifying the direction and magnitude of socio-economic variables on Canadian fertility. The results of this study can be used as a guideline to understand and evaluate the future population growth, labour force growth, family structure, and other human relations.

Canada has been experiencing falling birth rates

since 1960. If this trend continues, a slower population growth in Canada is likely. This has implications for the future labour market. The decline in labour force may create problems for the future economic growth of Canada (e.g., development of energy resources). The Canadian government has to reconsider the future implications of their immigration policy (Denton and Spencer, 1978).

Current population projections indicate that the population growth may be somewhat slow during the next ten years. Our study indicates that the participation in the labour force of married women is a deterrent to fertility. Given the fact that women are asserting their role in the socio-economic life of the country, their labour force participation is likely to increase further in the future. Thus it is clear that the birth rate in Canada is likely to continue to be at a low level.

This has various consequences. Enrollment in schools and post secondary institutions will decline leading to the lay-off of some of those employed in education services. If the birth rate is low, the population becomes aged with the percent of people 65+ years forming a sizable chunk of the people. This leads to a heavy drain on old age security and health care programs. The old age dependency ratio increases leaving a heavy burden on the economically active population. There are also various other socio-political implications such as the conservatism due to aging which are not discussed here.

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APPENDIX A

TABLE A-1

FERTILITY EQUATION, SIMULTANEOUS EQUATION MODEL

DEPENDENT VARIABLE	WORKER	SCHOOL	CATHOLIC	AGEFTMAR	INCWAGES	FAMINC	CONSTANT	R^2	SEE
CHILDREN	-0.76995**	-0.16746*	0.88426*	0.08596*	0.35046		6.78272*	0.0926	2.5147
	(1.7)	(3.0)	(3.6)	(3.8)	(1.1)		(7.8)		
	-1.48746*	0.18965*	0.81094*	-0.07867*		0.02954**	6.29367*	0.1529	2.2713
	(3.9)	(3.6)	(3.7)	(4.1)		(1.8)	(9.7)		
FAMSIZE	-6.04854*	0.07079	0.68232*	-0.07999*	0.72086*		4.60183*	0.0127	2.6502
	(2.6)	(1.2)	(2.6)	(3.3)	(2.1)		(5.0)		
	-1.35082*	0.03035	0.53448*	-0.06437*		0.05494*	3.53076*	0.1042	1.6105
	(4.9)	(0.8)	(3.5)	(4.7)		(4.7)	(7.7)		

*Significant at 5% level
**Significant at 10% level
Dependent Variable: CHILDREN (Number of Children Ever Born)
FAMSIZE (Family Size)

TABLE A-2

LABOUR FORCE EQUATION, SIMULTANEOUS EQUATION MODEL

CHILDREN	FAMSIZE	INCWAGES	SCHOOL	IMIGRANT	TECHNIC	FAMINC	CONSTANT	R^2	SEE
0.05020** (1.5)		0.15971* (13.0)	0.01275 (1.0)	0.08002** (1.7)	0.09606** (1.6)	-0.07906* (2.5)	-0.07934 (0.4)	0.3149	0.3875
0.01465 (0.5)		0.14873* (13.7)	-0.00104 (0.1)	0.06510** (1.5)	0.08596** (1.5)		0.09933 (0.6)	0.3753	0.3660
	0.07196** (1.5)	0.16307* (12.2)	0.00148 (0.2)	0.10057* (2.0)	0.08321 (1.4)	-0.01046* (2.6)	-0.00479 (0.0)	0.3463	0.3770
	-0.01577 (0.5)	0.14323* (13.7)	-0.00401 (0.5)	0.05156 (1.2)	0.08973** (1.6)		0.22050** (1.9)	0.3906	0.3614

*Significant at 5% level
**Significant at 10% level

Dependent Variable: WORKER (Dichotomous Variable, Labour Force Statistics)

APPENDIX B

TABLE B-1

LABOUR FORCE PARTICIPATION EQUATION, LINEAR MODEL

INCOME GROUP	CHILDREN	FAMSIZE	INCWAGES \$000	FAMINC \$000	SCHOOL	IMIGRANT	TECHNIC	CONSTANT	R^2	SEE
Total	-0.25849 (0.9)		7.92782* (21.5)	-0.18389** (1.7)	-0.54243** (1.7)	0.33335 (0.2)	4.85285* (2.2)	13.6957* (4.0)	0.5410	14.2134
		0.53583 (1.3)	8.08981* (21.7)	-0.22779* (2.1)	-0.46439** (1.5)	0.71994 (0.4)	4.78455* (2.2)	10.9139* (3.3)	0.5418	14.2008
Low < \$5000	-0.45792 (1.0)		12.43347* (8.2)	-1.21349* (1.3)	-1.38485* (2.2)	-1.20332 (0.4)	-0.41779 (0.1)	23.48522	0.4081	14.2273
		1.43284** (1.9)	12.84922* (8.7)	-1.65794** (1.7)	-1.18242* (2.0)	-0.07289 (0.2)	0.51556 (0.1)	17.71789	0.4214	14.0669
Medium \$5000-15000	0.29697 (0.8)		8.94120* (18.6)	-0.32062 (0.9)	-0.20368 (0.5)	2.28261 (1.0)	4.39164** (1.7)	9.32284	0.5855	13.8115
		0.57224 (1.0)	9.02191* (18.0)	-0.36674 (1.0)	-0.25310 (0.6)	2.36138 (1.1)	4.28653** (1.7)	9.34288	0.5862	13.8005
High > \$15000	-1.83567** (1.9)		5.67148* (9.3)	-0.01189 (0.1)	-1.41930** (1.7)	-0.61530 (0.2)	8.72220** (1.9)	26.3391	0.6895	13.3811
		-0.73643 (0.7)	5.76241* (9.1)	-0.12749 (0.5	-1.02400 (1.2)	-0.46351 (0.1)	7.75550** (1.7)	22.19687	0.6717	13.7594

*Significant at 5% level
**Significant at 10% level
Ordinary Least Squares Estimation
Parentheses Values are the Estimated t-Statistics
Dependent Variable: WEEKS (number of weeks worked)

TABLE B.2

LABOUR FORCE PARTICIPATION EQUATION, LINEAR MODEL

INCOME GROUP	CHILDREN	FAMSIZE	INCWAGES $000	FAMINC $000	SCHOOL	IMIGRANT	TECHNIC	CONSTANT	R^2	SEE
Total	-0.01325** (1.8)		0.14597* (15.7)	-0.00541* (2.0)	-0.00350 (0.4)	0.05658 (1.4)	0.09331** (1.7)	0.25550* (2.9)	0.4026	0.3582
		0.00050 (0.1)	0.14894* (15.7)	-0.00596* (2.2)	-0.00009 (0.0)	0.06175** (1.5)	0.09381** (1.7)	0.18426 (2.2)	0.3982	0.3595
Low < $5000	-0.01240 (1.1)		0.20421* (6.8)	-0.02723 (1.2)	0.03169* (2.2)	0.02786 (0.4)	-0.01622 (0.1)	-0.04684	0.3623	0.3292
		0.00849 (0.5)	0.21105* (7.0)	-0.03016 (1.3)	0.03641* (2.6)	0.03793 (0.5)	-0.00576 (0.0)	-0.14551	0.3563	0.3307
Medium $5000-15000	-0.00302 (0.3)		0.16541* (16.5)	-0.00959 (1.1)	-0.01837** (1.6)	0.09977** (1.7)	0.10838** (1.6)	0.40992	0.3999	0.3701
		0.00093 (0.1)	0.16641* (16.6)	-0.00973 (1.1)	-0.01789** (1.6)	0.10168** (1.7)	0.10857** (1.6)	0.39446	0.3997	0.3702
High > $15000	-0.03249 (1.4)		0.11638* (11.6)	-0.00320 (0.5)	-0.03628** (1.9)	0.03321 (0.4)	0.14691 (1.4)	0.66827	0.6317	0.3112
		-0.01026 (0.4)	0.11822* (11.8)	-0.00585 (1.0)	-0.02890** (1.5)	0.03752 (0.4)	0.12904 (1.2)	0.58547	0.6188	0.3166

*Significant at 5% level
**Significant at 10% level
Ordinary Least Squares Estimation
Parentheses Values are the Computed t-Statistics
Dependent Variable: WORKER (Labour Force Status--Dichotomous Variable)